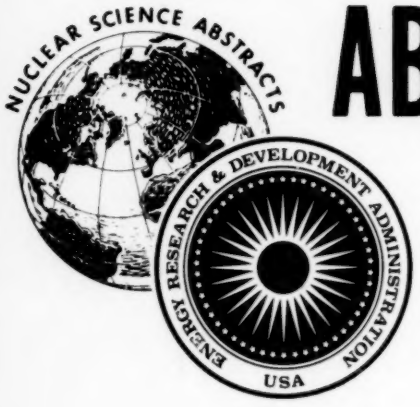
# NUCLEAR SCIENCE ABSTRACTS




Volume 33 Number 6

Abstracts 11417-14225

March 31, 1976

FINAL VOLUME
See Notice Inside

UNITED STATES
ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION

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# NOTICE

A title page for Volume 33, Numbers 1–6, is included at the back of this issue for use in binding those issues.

# CORRECTIONS

NSA Vol. 32, No. 11, Abst. 27291, line 3 should read: Lechel, V. 1975. Translation of CONF-721006-P1, pp 434-453 (NSA 29:9383).

NSA Vol. 32, No. 11, Report Number Index, page 134, CONF-750411-39 should be: CONF-721006-P1.

NSA Vol. 33, No. 2, Abst. 2700, line 1 should read: (ANL-75-43) CHEMICAL ENGINEERING DIVISION.

NSA Vol. 33, No. 2, Report Number Index, page 162, ANL-73-43 should be: ANL-75-43.

Volume 33, Number 6, March 31, 1976

# NUCLEAR SCIENCE ABSTRACTS

*A semimonthly publication of the USERDA Office of Public Affairs*
*Published by the ERDA Technical Information Center*

*Nuclear Science Abstracts* provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Energy Research and Development Administration and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

The following organizations scan and abstract the nuclear science literature in their respective countries for input to the International Nuclear Information System of the International Atomic Energy Agency. By special agreement, the input to INIS is simultaneously sent to the ERDA Technical Information Center to enhance the timeliness of coverage of that literature in *Nuclear Science Abstracts*.

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Numerous organizations, societies, and publishers throughout the world provide *Nuclear Science Abstracts* with advance page-proof copy of their publications.

A list of the journals scanned regularly and the abbreviations used appears in the January 15 issue of *Nuclear Science Abstracts* and is supplemented in the July 15 issue. The January 15 issue also describes the scope and arrangement of the subject matter covered in *Nuclear Science Abstracts*. The subject matter covered is also described in TID-4552, *Subject Scope of Nuclear Science Abstracts*, available free from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830. An outline of the subject categories appears in the Contents of each issue.

## NOTICE

The publication of *Nuclear Science Abstracts* is planned to be discontinued after Vol. 33, No. 12, dated June 30, 1976. *Atomindex*, published by the International Atomic Energy Agency and a product of the International Nuclear Information System (INIS), will provide essentially identical literature coverage, subject scope, abstracting and indexing with that of *NSA*. For all practical purposes the two journals are identical. The Energy Research and Development Administration, formerly the Atomic Energy Commission, has supported the concept and development of INIS for several years. At this time, it is quite apparent that the decentralized scanning, abstracting and indexing on a country-by-country basis is reliable and successful. Consequently, it is no longer necessary for the United States to bear the entire burden of publishing an abstract journal covering the world's nuclear literature. ERDA will continue to provide coverage of U. S. nuclear literature to INIS.

*Atomindex* is available on a subscription basis in the United States from UNIPUB, P. O. Box 433, Murray Hill Station, New York, New York 10016, for $150 per year including cumulative indexes. ($110 per year without cumulative indexes.) For others, *Atomindex* is available from the International Atomic Energy Agency, Publications Section, P. O. Box 590, A-1011, Vienna, Austria, at the same price.

ERDA's new journal, *ERDA Energy Research Abstracts (ERA)*, will contain abstracts and indexes to all literature of ERDA origin as well as nonnuclear energy information generated by foreign countries with which ERDA has agreements for cooperation. *ERA* is available to government agencies on the same basis as *NSA* and on an exchange basis to universities, research institutions, industrial firms, and publishers of scientific information.

The public may obtain *ERA* from the Superintendent of Documents, U. S. Government Printing Office, Washington, DC 20402. The annual subscription rate for the 12 regular issues including an annual cumulative index is $119 for domestic subscribers, and $148.75 for foreign subscribers. Individual issues will be priced at $7.40 domestic, and $9.25 foreign. Separate annual index cumulations will cost $30.50 domestic, and $38.15 foreign.

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## Personal Authors

Each author's name is indexed in the form appearing on the document abstracted, with the exception that given names are reduced to initials:

**SOLDAN, D.W.,** Shipping container for a bottle of radioactive material, 32:20442
**SOLDAT, J.K.,** Dosimetry of the radioactive noble gases, 32:19918 (BNWL-SA-4813)
**SOLOMAKHA, D.A.,** Measurement of the 1.15-μm wavelength of a helium--neon laser, 32:19555

## Subjects

The subject index consisting of entries naming specific materials, objects, and processes is arranged alphabetically. Document titles, informative phrases, or both specific to these entries are arranged alphabetically under the entries.

Examples:

**URANIUM ORES/GEOCHEMISTRY**
Change of uranium concentration in plagioclase of various zones of microcline--albite--oligoclase pegmatites of Karelia, 32:19704
**URANIUM ORES/LEACHING**
Preparation of uranium compounds (Patent), 32:19329
**URANIUM ORES/MINING**
The uranium mining and its importance for the energy supply, 32:19701
**URANIUM ORES/ORE PROCESSING**
Supplies for the fuel cycle for Spanish nuclear power plants, 32:19702
**URANIUM OXIDES**
See also URANIUM DIOXIDE
URANIUM OXIDES U3O8

## Corporates

Technical report literature is indexed using the name of the organization or institution responsible for the issuance of the report.

20457 (LA-5954) 100-MHz POWER AMPLIFIER DESIGN AND CONTROL FOR A HEAVY-ION ACCELERATOR. Lunsford, J. S.; Shipley, J. P.; Sutton, J. **(Los Alamos Scientific Lab., N. Mex. (USA)).** Jul 1975. 11p. Dep. NTIS $4.00.

is indexed as:

**LOS ALAMOS SCIENTIFIC LAB., N.MEX. (USA)**
100-MHz power amplifier design and control for a heavy-ion accelerator, 32:20457 (LA-5954)
Characterization of transuranic solid wastes from a plutonium processing facility, 32:19398 (LA-5993-MS)
Electrical breakdown and tracking characteristics of pulsed high voltages in cryogenic helium and nitrogen, 32:19495 (LA-UR-75-1032)
Engineering concepts for laser-fusion reactor applications, 32:19493 (LA-UR-75-736)
Evaluation of pre-impregnated resin-glass systems for insulating superconducting magnets, 32:19583 (LA-UR-75-1099)

## Report Numbers

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| | | |
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| 2874 | 32:19889 | Dep. NTIS, $9.25 |
| 3633 | 32:21097 | Dep. NTIS, $13.50 |
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| 165-b | 32:21507 | INIS |

# AVAILABILITY OF PUBLICATIONS ABSTRACTED

Public availability of all U. S. Energy Research and Development Administration reports is indicated in the report number indexes. The availability of other reports, when known, is also indicated. The availability of some unnumbered reports is given in the abstract.

Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from Xerox University Microfilms, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USERDA Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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***The Administrator of the Energy Research and Development Administration has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this agency. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through June 30, 1978.***

Volume 33, Number 6 March 31, 1976

# NUCLEAR SCIENCE ABSTRACTS

# CHEMISTRY

## Analytical and Separations Chemistry

*Refer also to abstracts 11520, 11599, 11998, and 14218.*

**11417** (AERE-PR/ACD-12) AERE HARWELL APPLIED CHEMISTRY DIVISION UNCLASSIFIED PROGRESS REPORT AND BIBLIOGRAPHY. For the Period 1 May 1974 to 31 March 1975. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Jul 1975. 29p. Dep. NTIS (US Sales Only) $4.50. UK £1.00.

Brief summaries are given of the work done in actinide analysis, analytical chemistry, applied electrochemistry, nuclear fuels, pile radiation chemistry, solid state chemistry, and separation processes. A bibliography lists the lectures, reports, and publications written during the report period. (JSR)

**11418** (CEA-N-1788) $^{238}$Pu QUALITY CONTROL. Billon, J. P.; Buffereau, M.; Sanson, C.; Vienney, J. (CEA Centre d'Etudes de Bruyeres-le-Chatel, 92-Montrouge (France)). Jun 1975. 15p. (In French). INIS.

The methods used to analyze $^{238}$Pu are reviewed and the errors in the determination of $^{238}$Pu concentration are studied. Some results on the main impurities are given. (FR)

**11419** (ICP-1079) ANALYTICAL CHEMISTRY BRANCH ANNUAL REPORT FOR FISCAL YEAR 1975. Crawford, J. M. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs—Operations Office). Oct 1975. Contract E(10-1)-1375. 151p. Dep. NTIS $7.60.

The Analytical Chemistry Branch Annual Report presents the non-routine, significant analytical services and supporting development work for FY-1975. The analytical and technical support activities for the Idaho Chemical Programs and other INEL and outside contractors include mass spectrometry, gas chromatography, atomic absorption spectrophotometry, emission spectrography, x-ray diffractometry, radiochemistry, spectrophotometry, titrimetry, gravimetry, coulometry, quality control, and remote techniques. Improvement of equipment, analytical techniques, and methods are a significant part of this report. In an appendix specific methods are given for the determination of Gd by x-ray fluorescence, spectrophotometric determination of nitrate with chromatropic acid, spectrophotometric determination of milligram amounts of U in samples containing Th, triisooctylamine extraction-fluorophotometric determination of U, separation of U for mass spectrometric analysis, and dissolution of HTGR coated fuel particles for the determination of U and Th. (JSR)

**11420** MILLIPORE FILTERS IN SOIL CHEMISTRY: APPLICATION TO THE CHARACTERIZATION OF ISOTOPIC DILUTION KINETICS OF IONS IN THE SOIL. Fardeau, J. C.; Guiraud, G. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Service de Radio-Agronomie). Ann. Agron.; 25: No. 1, 113-117(1974). (In French).

The knowledge of isotopic dilution kinetics of ions in soil-solution systems requires the exact measure of specific activity of these ions in the solutions. A method based on the use of millipore filters with pores of 0.2 micron diameter is described. With this technique, experimental results within thirty seconds or one minute after the beginning of the contact between tracer and soil are obtained. A centrifugation is necessary only once at the end of the experiment. The application is given in this paper for nine nutritive elements of agronomical interest. (FR)

### *Activation and Nuclear Reaction Procedures*

*Refer also to abstracts 12069, 12346, 12448, 13803, and 14042.*

**11421** (CONF-7209130-, pp 63-78) NUCLEAR MICROANALYSIS OF $^{16}$O AND $^{18}$O IN NEAR-SURFACE REGIONS OF SOLIDS. Applications. A. Microanalysis of $^{16}$O and $^{18}$O by the Direct Observation of Nuclear Reactions. Amsel, G. (Ecole Normale Superieure, Paris). 1972.

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

The inadequacy of other methods of isotopic analysis in solid-state physics and electrochemistry is briefly reviewed as an introduction to a description of the use of direct observation of nuclear reactions for the microanalysis of $^{18}$O and $^{16}$O. The general principles of the method in which $^{18}$O is measured by the (p,$\alpha$) reaction and $^{16}$O by the (d,p) reaction are outlined. The differences in the experimental techniques for thin films and thick films are discussed in detail. (JSR)

**11422** (CONF-7209130-, pp 138-143) NUCLEAR MICROANALYSIS OF $^{16}$O AND $^{18}$O IN NEAR-SURFACE REGIONS OF SOLIDS. B. The Anodic Oxidation of Tantalum and its Application to the Isotopic Analysis of Oxygen for Standards, in Exchange Studies and in Biology. Amsel, G. (Ecole Normale Superieure, Paris). 1972.

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

The suitability of the anodic oxidation of Ta for the determination of the oxygen isotopic composition is outlined. Its use in the preparation of oxygen isotopic standards, sampling of the oxygen isotopic composition of water in pure state or in mixture with other materials, and the applications to in situ and in vivo tests on animals or vegetables is discussed and briefly illustrated. (JSR)

**11423** (CONF-7209130-, pp 143-148) NUCLEAR MICROANALYSIS OF $^{16}$O AND $^{18}$O IN NEAR-SURFACE REGIONS OF SOLIDS. C. Applications to Solid State Electrochemistry and Thin Films. Amsel, G. (Ecole Normale Superieure, Paris). 1972.

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

The studies made on film growth on materials in aqueous or organic solutions are summarized. These include analysis of kinetics and mechanisms of film growth, ion transfer mechanisms, origin of oxygen in films, oxygen transport mechanism, and oxygen self-diffusion phenomena. A bibliography listing the details of the work done in these areas and the results obtained is given. (JSR)

**11424** (CONF-7209130-, pp 151-158) STUDY OF THE PULMONARY EXTRA-VASCULAR COMPARTMENTAL WATER IN THE RAT WITH TRITIATED WATER AND WATER LABELLED WITH OXYGEN-18. Basset, G. (Hopital Bichat, Paris). 1972. (In French).

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

Water labelled with $^{18}O$ can be measured in biological media by nuclear methods after anodic oxidation on a Ta plate. By the Chinard multiple indicator method, nuclear reaction analysis with protons measures a pulmonary extra-vascular compartmental water identical to that of tritiated water. Water labelled with $^{18}O$ can be the ideal tracer for repeated studies in man. (tr-auth)

**11425** (CONF-741040-P1, pp 287-297) NEAR-SURFACE ANALYSIS WITH NUCLEAR REACTIONS AND SCATTERING. Dunning, K. L.; Hirvonen, J. K. (Naval Research Lab., Washington, DC). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Very useful information about the elemental composition of solids in the surface and near-surface regions can be obtained with small accelerators and suitable auxiliary apparatus. Two methods which produce data from which quantitative concentration depth profiles can be constructed and which have been used extensively at this laboratory are: nuclear resonance profiling and Rutherford backscattering. The first method is described in detail. Data are given on profiles of Al and Al + Na films implanted on silicon substrates. Rutherford backscattering spectra for chromium implanted into silicon dioxide are used to illustrate the improved depth sensitivity that can be obtained with a magnetic spectrometer in depth concentration profiles of heavy impurities relative to that obtainable with a conventional semiconductor detector. (JGB)

**11426** (NIM-1636) TRACE ELEMENTS IN DIAMONDS FROM THE PREMIER, FINSCH, AND JAGERSFONTEIN MINES, AND THEIR PETRIGENETIC SIGNIFICANCE. Fesq, H. W.; Bibby, D. M.; Erasmus, C. S.; Kable, E. J. D. (National Inst. for Metallurgy, Johannesburg (South Africa)). 31 Oct 1975. 32p. Dep. NTIS (US Sales Only) $5.00.

Neutron-activation studies of the impurity chemistry of more than 1500 natural diamonds from three South African kimberlite sources, Premier, Finsch, and Jagersfontein, provide evidence for the presence of submicroscopic inclusions of a quenched (or temperature re-equilibrated) melt from which these diamonds crystallized. These microscopic inclusions of parental magma contain variable amounts of fluids rich in water and carbon dioxide, as well as iron–nickel–copper–cobalt sulfides, and a major silicate phase, which is remarkably constant in composition irrespective of the source of the diamonds and the age of emplacement of their host kimberlite. These microscopic inclusions are present in varying amounts in all the diamonds that were analyzed, and may even dominate the impurity chemistry of diamonds having observable mineral inclusions. An estimate of the composition of the major elements in the silicate melt indicates that the diamonds that were investigated crystallized from picritic magma rich in water and carbon dioxide in the presence of immiscible iron–nickel–copper–cobalt sulfides. (auth)

**11427** (PINSTECH/CHEM-2) DETERMINATION OF COPPER IN SAINDAK VALLEY, BALUCHISTAN, COPPER FIND. Qureshi, I. H.; Cheema, M. N. (Pakistan Inst. of Nuclear Science and Technology, Rawalpindi). Apr 1974. 21p. INIS.

16 refs.

A special project on the determination of copper and molybdenum in Saindak Valley, Baluchistan, copper bearing ores was undertaken in June 1973. For the analysis of copper both destructive and nondestructive analytical techniques were studied. A number of reagents were investigated for the dissolution of copper from the ore samples as the accuracy of the destructive analysis depends to a large extent on the efficient dissolution. For non-destructive analysis a simple and rapid method was developed using neutron activation analysis techniques. The factors such as neutron irradiation time, radioactive decay and interference from matrix elements were studied and optimized. The accuracy of the results was cross-checked by analyzing the samples using other destructive and non-destructive techniques namely, iometry, atomic absorption spectrophotometry, emission spectrography and x-ray fluorescence. Several hundred samples were analyzed and the results were forwarded to Geological Survey of Pakistan for preparing geochemical anomaly maps of the area. (INIS)

**11428** ($\alpha$,p) AND ($\alpha$,d) REACTIONS ON LITHIUM AND CARBON NUCLEI AND TESTS OF THRESHOLD STATES. Umurzakov, B. S.; Navalikhin, L. V.; Shalpykov, A.; Cholokov, K. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 54-59(1975). (In Russian)

A method is presented for determining oxygen in ionic monocrystals using fast-neutron activation analysis. It is shown that with NaCl monocrystals containing NaOH, the method has a sensitivity of $1.6 \times 10^{-2}$%. The error in the method is ±20%. The specific electrical conductivity of NaCl crystals with NaOH impurity is lower than that of pure NaCl crystals, with a minimum value for NaCl crystals having an oxygen concentration of $1.6 \times 10^{-2}$%. (tr-auth)

**11429** APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE EVALUATION OF PLACER GOLD CONCENTRATIONS. Plant, J. (Inst. of Geological Sciences, London); Coleman, R. F. pp 373-381 of Proceedings of the Fourth International Geochemical Exploration Symposium. Jones, M. J. (ed.). London; Institution of Mining and Metallurgy (1973).

From 4th international geochemical exploration symposium; London, Eng. (17 Apr 1972).

A method of neutron activation analysis for gold in large samples of geologic materials is described in relation to the economic assessment of the valley deposits in the Strath of Kildonan, Sutherland. The gold content of samples consisting of up to 500 g of unground material is measured by neutron activation analysis by use of the reaction $^{197}Au$ (n,$\gamma$) $^{198}Au$. The material consists of alluvium and fluvioglacial detritus. Orientation studies in the tributary drainage of the area indicated that native gold occurs in particles of up to 2 mm in diameter: the concentration of gold in the alluvium is approximately 0.1 ppM; the estimated mean density of the gold is 16.5. The neutron activation method enables up to 500 g of material to be analyzed nondestructively at a cost of £2 to £3 per sample. Sample preparation is minimal and cost is, therefore, independent of sample size and productivity is high (20 samples per man-day). The combined sampling and analytical reproducibility compares favorably with that attained by atomic absorption spectrophotometric or fire assay methods, which involve the analysis of only 20 to 100 g of material. The limit of detection of the method is 0.01 ppM on 500 g of material. A limit of detection of better than 0.005 ppM was obtained. The incorporation of the analytical technique into a general procedure, which permitted calculation of the local gold content and classification of the type and source of the unconsolidated sediments, is described. (auth)

**11430** APPLICATION OF FISSION-TRACK AND NEUTRON ACTIVATION METHODS TO GEOCHEMICAL EXPLORATION. Bowie, S. H. U.; Simpson, P. R.; Rice, C. M. (Inst. of Geological Sciences, London). pp 359-372 of Proceedings of the Fourth International Geochemical Exploration Symposium. Jones, M. J. (ed.). London; Institution of Mining and Metallurgy (1973).

From 4th international geochemical exploration symposium; London, Eng. (17 Apr 1972).

Fission-track radiography, supported by a delayed neutron method of analysis and field observations, was used to investigate uranium mineralization controls in parts of Scotland. The areas selected were the Criffel granodiorite, Aberdeenshire granites, Helmsdale granite and Old Red Sandstone sediments of the Orcadian cuvette, including the Ousdale arkose. Special attention was given to the comparison of rocks from mineralized and non-mineralized environments. The study has indicated that magmatic fractionation is unlikely to have resulted in uranium enrichment associated with the Criffel granodiorite and the Helmsdale granite. The Criffel granodiorite mineralization clearly post-dates granitic intrusion, as was previously shown by uranium and lead dating. Fission-track radiography has proved particularly effective in (a) defining the background non-mineralized situation for the granitic rocks, (b) distinguishing between syngenetic, diagenetic and epigenetic uranium in the sediments and (c) documenting the changes in mineralogy and uranium location as enrichment proceeds. In granites not known to have associated uranium mineralization of economic grades, there is some enrichment of uranium in faulted and unfaulted granite in association with martite, hematite, limonite, chlorite and sericite. (auth)

**11431** FISSION-TRACK RADIOGRAPHY OF URANIUM AND THORIUM IN RADIOACTIVE MINERALS. Wollenberg, H. A. (Univ. of California, Berkeley). pp 347-358 of Proceedings of the Fourth International Geochemical Exploration Symposium. Jones, M. J. (ed.). London; Institution of Mining and Metallurgy (1973).

From 4th international geochemical exploration symposium; London, Eng. (17 Apr 1972).

The fission-track method is a quick, relatively simple and inexpensive technique for the determination of the location and abundance of uranium and, in some cases, thorium in thin or polished sections of rocks. Sections with appropriate track detectors are exposed, first, to thermal neutrons to induce only

U to fission, and then to fast neutrons for fission of U plus Th. The detectors are etched to reveal the damaged areas (tracks) caused by passage of massively charged fission fragments. High-quality muscovite mica is the preferable track detector for minerals with U contents greater than 10 to 15 ppM. Polycarbonate plastic (Lexan or Makrofol) is preferred as a track detector for low contents of U and Th. Thorium is determined successfully if the Th/U ratio in the mineral is sufficiently large. Relative errors (from counting statistics) in Th are less than 25% if Th/U is greater than 3; for ratios less than 3 the errors increase rapidly and exceed 40 to 50% if Th/U is less than 1. The method was applied to the study of U and Th in granitic rocks of the Sierra Nevada batholith, California, and in strongly contrasting mineralized terrains in south and east Greenland. Fission-track examinations of thin sections of mineralized fault-zone breccia from east Greenland indicated that U is strongly associated with limonitic material in thin fluoritized veinlets. By combination of the results of fission-track studies and an electron-microprobe analysis of the minerals, the abundance of U and Th may be correlated with that of other elements. (auth)

**11432** DETERMINATION OF HYDROGEN CONCENTRATION IN ZIRCONIUM ALLOYS BY CAPTURE GAMMA RADIATION. Wille, P.; Schmidth, W. (Gessellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH., Geesthacht, Ger.). pp 735-739 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A tube of Zircaloy was scanned in order to determine the hydrogen distribution along its axis from hydrogen capture gamma rays. The hydrogen distribution was the result of diffusion and precipitation of hydrogen in Zircaloy. The sensitivity of the method is demonstrated. (3 figures) (auth)

**11433** NONDESTRUCTIVE NUCLEAR FUEL ASSAY BY NEUTRON CAPTURE GAMMA-RAY SPECTROMETRY. Weitkamp, C.; Matussek, P.; Ottmar, H. (Kernforschungszentrum, Karlsruhe, Ger.). pp 749-756 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Spectrometry of primary $\gamma$-rays following capture of thermal neutrons lends itself to the quantitative nondestructive analysis of nuclear fuel. The method suffers less from mutual perturbation of the different isotopes than passive $\gamma$-assay, but its use is limited by low speed, the need for a reactor, and finite detector lifetime. (2 tables) (auth)

**11434** CONTEMPORARY METHODS FOR THE DETERMINATION OF MICROQUANTITIES OF URANIUM AND THORIUM IN ROCKS AND MINERALS. Bozhichko, M. A.; Malyasova, Z. V. pp 243-244 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian).

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Physical and chemical methods for the determination of microquantities of U and Th in rocks and minerals during geochemical studies were described. The most precise and sensitive are neutron activation and isotope dilution. The most widely used chemical methods are luminescence determination of U and colorimetric determination of U and Th. (JSR)

**11435** CONTEMPORARY METHODS FOR THE DETERMINATION OF SMALL QUANTITIES OF URANIUM AND THORIUM IN ROCKS AND MINERALS AND POSSIBILITIES FOR THEIR DEVELOPMENT. Nemodruk, A. A.; Myasoedov, B. F.; Karalova, Z. K. pp 245-250 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian).

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The basic characteristics in the determination of U and Th are briefly given. For U the best methods are luminescence with dilution and preliminary extraction separation, photometry using organic reagents, isotope dilution, radiometric, and spectral and x-ray fluorescence. For Th the best methods are mass spectrometry, activation fluorimetry, photometry, spectroscopy, radiometry, and amperometry. (tr-auth)

**11436** NEW METHODS FOR THE DETERMINATION OF THE URANIUM-235 TO URANIUM-238 RATIO IN NATURAL OBJECTS. Malyshev, V. I.; Yakubovich, A. L.; Kotsen, M. E.; Salmin, Yu. P.; Sokolova, Z. A.; Sumin, L. V.; Kharlamov, V. I.; Shiryaeva, M. B. pp 266-271 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian).

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Mass spectrometric, $\alpha$-$\gamma$ coincidence spectrometric, $\gamma$ spectrometric, and neutron activation methods for the determination of U isotopes in rocks and minerals are described. (tr-auth)

**11437** CONTRIBUTION TO THE STUDY OF THE DETERMINATION OF SULFUR IN SODIUM BY PROTON ACTIVATION. Nordmann, F.; Fluhr, A.; Tinelli, G.; Engelmann, C. (Ecole Superieure de Chimie, 68-Mulhouse (France); CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service d'Analyses et d'Etudes en Chimie Nucleaire et Isotopique). Analusis; 3: No. 3, 171-176(Mar 1975). (In French).

From 4th international conference on atomic spectroscopy; Toronto, Canada (29 Oct 1973).

A method for the determination of sulfur in sodium, involving the chemical separation of chlorine-34m, is described. $10^{-2}\mu g \cdot g^{-1}$ sulfur in sodium can be determined by this method which takes less than an hour and gives a precipitate of high radiochemical purity. The sulfur and chlorine activation curves, relative to the formation of chlorine-34m from these elements, are plotted under the experimental conditions. Some examples of analytical results are given; concentrations of $0.6\ \mu g \cdot g^{-1}$ in particular were determined. (FR)

**11438** DETERMINATION OF RHENIUM IN MOLYBDENUM BY NEUTRON ACTIVATION. Samadi, A. A.; Fedoroff, M. (Centre National de la Recherche Scientifique, 94-Vitry-sur-Seine (France). Centre d'Etudes de Chimie Metallurgique). C. R. Hebd. Seances Acad. Sci., Ser. C; 280: No. 16, 1015-1017(28 Apr 1975). (In French).

The determination of rhenium in molybdenum is achieved by thermal neutron activation. Rhenium is separated by an extraction in basic medium followed by an ion-exchange in thiocyanate medium. This method gives a detection limit of $1.5 \times 10^{-3}$g after an irradiation of 20 min in a neutron flux of $4 \times 10^{12} cm^{-2} \times s^{-1}$. (FR)

**11439** NUCLEAR ANALYTICAL METHODS IN CZECHOSLOVAKIA. Tolgyessy, J. (Slovenska Vysoka Skola Technicka, Bratislava (Czechoslovakia). Chemickotechnologicka Fakulta). Jad. Energ.; 20: No. 10, 349-354(Oct 1974). (In Slovak).

The results achieved so far by Czechoslovak specialists in the development of tracer techniques, activation analysis techniques, and of non-nuclear interaction analytical techniques are reviewed. (INIS)

**11440** APPLICATION OF NEUTRON ACTIVATION ANALYSIS TO THE DETERMINATION OF OXYGEN IN Al AND Al ALLOYS. Beurton, G. (Compagnie de Produits Chimiques et Electrometallurgiques Pechiney, Centre de Recherches de Voreppe, 38 (France)). Mem. Sci. Rev. Metall.; 72: No. 1, 95-100(Jan 1975). (In French).

The principles of the 14-MeV neutron activation analysis are given. The method was applied to the determination of oxygen in Al and Al alloys (surface and depth distribution of oxygen). (FR)

**11441** CHARACTERIZATION OF THIN LAYERS OF ALUMINIUM NITRIDE BY NUCLEAR ANALYSIS METHODS. Tardy, J.; Cachard, A. (Lyon-1 Univ., 69 (France)); Thomas, J. P.; Engerran, J. (Lyon-1 Univ., 69-Villeurbanne (France). Inst. de Physique Nucleaire). Vide; 29: No. 173, 359-363(Sep 1974). (In French)

From 4th international congress AVISEM 74. Application of electronic and ionic processes; Toulouse, France (8 Oct 1974).

A typical application of nuclear techniques to the analysis of thin aluminium nitride films is presented. It is shown how the stoichiometry of the layers and their oxygen and/or argon contamination can be determined by the direct observation of deuteron-induced nuclear reactions and elastic back-scattering of $^6Li^+$ ions. A comparison with optical absorption methods (IR or UV) shows the inadequacy and lack of sensitivity of the latter. (FR)

**11442** SUBSTOICHIOMETRIC AND NON-DESTRUCTIVE DETERMINATION OF TRACE IMPURITIES IN HIGH-PURITY OPTICAL GLASSES BY NEUTRON ACTIVATION ANALYSIS. Kudo, K.; Kobayashi, K.; Shigematsu, T. (Nippon Telegraph and Telephone Public Corp., Tokai). J. Radioanal. Chem.; 27: No. 2, 329-344(1975).

A method of radioactivation analysis has been developed for the determination of 17 elements as impurities in high-purity optical glasses. The substoichiometric extraction of platinum with dithizone was studied and a simple procedure was proposed for the determination of platinum. Copper and manganese were also determined substoichiometrically by the extractions with

dithizone and with thenoyltrifluoracetone, respectively. The non-destructive γ-ray spectrometry using a Ge(Li) detector has been applied for the determination of the other 14 elements (Ag, Co, Cr, Eu, Fe, Ir, Sc, Zn, Cs, Hf, Rb, Sb, Ta, and Tb). Impurity elements at the ppb level were analyzed by the proposed method and it is shown that the method is reliable for the determination of trace impurities in high-purity optical glasses. (auth)

**11443** SYSTEMATIC ANALYSIS OF TRACE ELEMENTS IN SEAWATER BY NEUTRON ACTIVATION. May, S.; Piccot, D.; Pinte, G. (CEN de Saclay, Gif-sur-Yvette, France). J. Radioanal. Chem.; 27: No. 2, 353-368(1975). (In French)

The trace elements in seawater, particularly the pollutant elements (Cu, Cd, As, Zn, Hg, and Cr) are present in very low concentrations (of the order of $10^{-9}$ g/ml). For the determination of the concentration of these elements neutron activation analysis has been used successfully. The separation of the impurities has been studied using radioactive tracers by coprecipitation with carriers and on ion exchange resins. The preconcentration techniques applied before the irradiation introduces too large "blank" values, which can be reduced by etching the containers with HF–EDTA. In order to have representative samples, the water must be quickly frozen after taking out from the sea. With these precautions, the method developed allows to analyze samples of 3 ml volumes. The results of seawater sample analyses from different areas are presented. (auth)

**11444** DISTRIBUTION PATTERNS OF FIREARM DISCHARGE RESIDUES AS REVEALED BY NEUTRON ACTIVATION ANALYSIS. Pillay, K. K. S.; Driscoll, D. C.; Jester, W. A. (Pennsylvania State Univ., University Park). J. Radioanal. Chem.; 27: No. 2, 421-438(1975).

A systematic investigation using a variety of handguns has revealed the existence of distinguishable distribution patterns of firearm discharge residues on surfaces below the flight path of a bullet. The residues are identifiable even at distances of 12 meters from the gun using nondestructive neutron activation analysis. The results of these investigations show that the distribution pattern for a gun is reproducible using similar ammunition and that there exist two distinct regions to the patterns developed between the firearm and the target—one with respect to the position of the gun and the other in the vicinity of the target. The judicious applications of these findings could be of significant value in criminal investigations. (auth)

**11445** DETERMINATION OF TRACE ELEMENTS IN BEACH ASPHALTS BY NEUTRON ACTIVATION ANALYSIS. May, L. A. (Univ. of Alabama, Birmingham); Presley, B. J. J. Radioanal. Chem.; 27: No. 2, 439-445(1975).

The feasibility of using trace multielement data obtained from neutron activation analysis to identify the source of crude oil residues was recently demonstrated. This paper presents the concentrations of Br, Co, Cr, Sb, Sc, Zn, and V/Ni, for 30 crude oil residues collected from beaches (beach asphalt), using 1 g samples. The method does not require chemical separation or post-irradiation concentration. The average standard deviation for the V/Ni ratio was ±0.39. (auth)

**11446** DETERMINATION OF TRACE OXYGEN IN LEAD BY HELIUM-3 AND HELIUM-4 ACTIVATION ANALYSIS. Vandecasteele, C.; Hoste, J. (Rijksuniversiteit, Ghent). J. Radioanal. Chem.; 27: No. 2, 465-473(1975).

The determination of oxygen in lead by $^{3}He$ and $^{4}He$ activation analysis was studied. Both methods were applied to the same material containing 0.9 $\mu g \cdot g^{-1}$ of oxygen. The $^{18}F$ formed from oxygen was separated from matrix activities by extraction of Po with N-benzoyl-N-fenylhydroxylamine, followed by distillation of fluorosilicic acid and precipitation of lead fluorochloride ($^{4}He$ activation) or by distillation followed by precipitation ($^{3}He$ activation). The yield of the separation, which amounted on the average to 68%, was determined via the $^{19}F(n,^{4}He)^{16}N$ reaction. The coefficients of variation were 21 and 45% for $^{4}He$ and $^{3}He$ activation analysis, respectively, thus indicating a less homogeneous distribution of the oxygen. Nuclear interferences of sodium and fluorine were shown to be negligible. (auth)

## Chemical and Spectral Procedures

*Refer also to abstracts 11500 and 12678.*

**11447** (BARC–772) CONTROLLED POTENTIAL COULOMETER FOR THE ESTIMATION OF PLUTONIUM. Ponkshe, M. R.; Samuel, J. K. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). 1974. 14p. Dep. NTIS (US Sales Only) $4.50.

A transistorized, controlled potential coulometer developed in Radiochemistry Division is described. The instrument features maximum possible use of indigenously available circuit components. Experimental results obtained so far indicate that quantitative estimation of plutonium can be done with the unit to an accuracy of ±0.2%. (auth)

**11448** (BARC-788) SPECTROGRAPHIC ANALYSIS OF STRONTIUM CARBONATE FOR TRACE IMPURITIES. Vengsarkar, B. R.; Saksena, M. D. (Bhabha Atomic Research Centre, Bombay (India). Spectroscopy Div.). 1975. 15p. Dep NTIS (US Sales Only) $4.50.

A spectrographic method for the determination of Al, Cu, Fe, Mg, Pb, Ba, Ca, Cd, Na, and Zn in $SrCO_3$ in trace amounts is described. Cr is used as an internal standard. The analysis for Na and Zn is only semi-quantitative because of a strong matrix line masking the Na and Zn lines. The preparation of the standards is described. (JSR)

**11449** (CONF-7209130–, pp 21-28) NMR AND ESR SPECTROSCOPY OF $^{17}O$ LABELLED COMPOUNDS. Silver, B. L. (Technion-Israel Inst. of Tech., Haifa). 1972.

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

The use of $^{17}O$ NMR measurements for the study of chemical mechanisms and kinetics is briefly reviewed. ESR studies using $^{17}O$ have concentrated on the identification of inorganic radicals and the elucidation of electron distribution in a wide variety of molecules. The implications of the spectra observed are illustrated by a brief discussion of the nature of hyperfine interactions. (JSR)

**11450** (CONF-7209130–, pp 40-50) MASS SPECTROMETRY ANALYSIS OF COMPOUNDS ENRICHED IN $^{17}O$ AND $^{18}O$. Gerster, R. (CEN, Cadarache, France). 1972. (In French)

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

After a few general remarks on the instrumental aspects associated to mass spectrometry measurements, one of the instruments available at the laboratory is briefly described : the aim of this apparatus is to know with good accuracy the isotopic content of small concentrations (< 100 ppm) or amounts (< 0.05 μmole) of $O_2$ and $CO_2$. The methods used to know the isotopic content of simple compounds such as $H_2O$, CO, $O_2$, $CO_2$ are then reviewed. In many cases, the analysis of more complex products involves a conversion into one of these compounds, every substance constituting in a way a specific case. Reactions leading to a $CO_2$ release can be perfectly controlled by means of a double isotopic dilution technique using $^{13}C^{18}O_2$. The isotopic enrichment of carboxylated molecules can be determined on the $CO_2$ evolved during a flash pyrolysis realized in an induction furnace. Difficulties encountered in these measurements are numerous and request much care. (auth)

**11451** (CONF-7209130–, pp 51-62) CALCULATION OF THE ISOTOPIC CONTENTS OF OXYGEN AND CARBON DIOXIDE. Mass Spectrometry Analysis in Conditions of Isotopic Equilibrium and Nonequilibrium. Thibault, P. (CEN, Cadarache, France). 1972. (In French)

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

The use of a mass spectrometer the resolving power of which is not sufficient to detect two neighboring masses like the ones corresponding to molecules $^{12}C^{18}O^{18}O$ and $^{13}C^{18}O^{17}O$, sets some problems with respect to the determination of isotopic contents. These problems are considered for two simple molecules, oxygen and carbon dioxide, in conditions where the analysis is performed on samples in isotopic equilibrium or not. In the first case, calculations of isotopic contents can be made rigorously; in the second case, some approximations need to be introduced. Furthermore, when the gas is out of equilibrium, the immediate application of formulas like $R/_{2+R}$, currently encountered in literature, introduces enormous errors. (auth)

**11452** (CONF-7209130–, pp 189-196) USE OF OXYGEN ISOTOPES IN EARTH SCIENCES: PROBLEMS AND APPLICATIONS. Letolle, R. (Univ., Paris). 1972. (In French)

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

The universally adopted $^{18}O$ standard for earth sciences is briefly described. The mass spectrometer must be used to measure the very small isotopic abundances of this isotope. The

preparation of samples is reviewed. The application of mass spectrometric methods to the measurement of the $^{18}O$ concentration in carbonates, phosphates, sulfates, silicates, and oxides and the principal problems encountered are summarized. (JSR)

**11453** (CONF-7209130–, pp 226-230) ISOTOPIC ANALYSIS OF THE OXYGEN OF MICROQUANTITIES OF WATER. Application to the Study of Hail and to the Determination of the Isotopic Fractionation Coefficients at Equilibrium Between the Hail and the Water Vapor. Majoube, M. (CEN de Saclay, Gif-sur-Yvette, France). 1972. (In French)

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

The design of a mass spectrometer for isotopic analysis of the oxygen of water is briefly reviewed with emphasis on the two principal problems, the memory effect and the corrosion of the ion source. The application of this mass spectrometer to the determination of the solid-water vapor fractionation coefficients and to the study of the formation of hail is described. The $^{18}O$ and D concentration in two hailstones is shown as a function of size. (JSR)

**11454** *(UCID-16966)* DETERMINATION OF NEPTUNIUM IN A U-0.5 PERCENT Np ALLOY BY CONTROLLED-POTENTIAL COULOMETRY. Magana, J. W.; Walden, J. C.; Harrar, J. E. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. 9p. Dep. NTIS $4.50.

A published procedure for the determination of neptunium in uranium-neptunium alloys has been checked and applied to the analysis of U-0.5 percent Np alloys. Both the accuracy and precision of the method are within a few percent, and no separations are required. After set-up, no standard solutions are required for long-term reliability. After sample dissolution, the time required for analytical measurement is approximately 30 minutes. (auth)

**11455** (UCRL-15964) CONTINUED STUDIES OF CALORIMETER PERFORMANCE AT THE LAWRENCE LIVERMORE LABORATORY. Steward, S. A.; Tsugawa, R. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Nov 1975. Contract W-7405-Eng-48. 16p. Dep. NTIS $4.00.

Calibrations of two calorimeters used for tritium and plutonium assays were made. Data from three new standards of about 0.5, 1, and 5 W were added to the results of a previous report and analyzed together. The accuracies of both calorimeters appear to fall within the specified 0.5 percent, although the data now available for the large calorimeter is insufficient to permit a more definite conclusion. An expression of the bias correction for each calorimeter with respect to the sample power cannot be determined. The bias of the medium thermopile-type calorimeter tends to be positive, however, and that of the large resistance-bridge design appears to be negative. (auth)

**11456** *(UCRL-76956)* DETECTOR SYSTEM FOR IN-SITU SPECTROMETRIC ANALYSIS OF $^{241}Am$ AND Pu IN SOIL. Kirby, J. A.; Anspaugh, L. R.; Phelps, P. L.; Amantrout, G. A.; Sawyer, D. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1975. Contract W-7405-Eng-48. 9p. (CONF-751116-12). Dep. NTIS $4.50.

From nuclear science symposium; San Francisco, California, USA *(17 Nov 1975)*.

This system for quantitative analysis of Pu in soil via $^{241}Am$ has four 2.5-mm high-purity Ge detectors of 33 $cm^2$ total detecting surface area. These detectors are paralleled by gating circuitry to avoid the degradation of energy resolution associated with electronic output summing. In field tests the system was approximately three times as sensitive as a 70-$cm^3$ Ge(Li) detector and approximately an order of magnitude more sensitive than the FIDLER system. (auth)

**11457** $^{137}Cs$ DETERMINATION IN MILK WITHOUT ASHING. Antonova, V. A.; Prokof'ev, O. N.; Strelko, V. V.; Kul'bich, T. S. Gig. Sanit.; No. 4, 65-66(Apr 1975). (In Russian)

Cesium-137 in milk is concentrated by sorption in silica gel, using 15 g of silica gel for 1.5 to 2 liters of milk with a flowrate of 300 ml/hr. The $^{137}Cs$ is eluted by 3 hr standing in 300 ml of 1 M HCl and is determined in the eluate by the antimony iodide method. (TTT)

**11458** LIQUID HELIUM FREEZING TECHNIQUE FOR ISOTOPIC ANALYSIS OF $\mu$1 SAMPLES OF INERT GASES. Freyer, H. D.; Kobel, K. (Kernforschungsanlage, Juelich, Ger.). J. Phys., E (London); 8: No. 9, 712-713(Sep 1975).

A liquid helium freezing technique in combination with the Micromass 602C mass spectrometer fitted with the small volume inlet system is described allowing precise isotopic analyses of inert gases of sample volumes down to 0.02 atm $cm^3$. (auth)

**11459** DETERMINATION OF LOW CONCENTRATIONS OF URANIUM IN ORES AND SOLID MILL PRODUCTS BY X-RAY FLUORESCENCE SPECTROMETRY. Zimmerman, J. B.; Reynolds, V. Catalogue No. M38-9/75-4. Ottawa; Department of Energy, Mines, and Resources (1975). 10p. $0.50.

A direct x-ray fluorescence method for the rapid determination of U in low-grade ores and rocks of variable matrix is described. Accuracy and precision are comparable to the optical fluorescence method down to the 0.01% U level. The effects of matrix composition on U intensities are eliminated by a double-dilution technique, in which the dilutions are kept small to minimize intensity losses. (Metals Abstr.)

**11460** BONE MINERAL CONTENT IN THE FOREARM MEASURED BY PHOTON ABSORPTIOMETRY. Principles and Reliability. Christiansen, C. (Glostrup Sygehus, Copenhagen); Jensen, J.; Roedbro, P. Scand. J. Clin. Lab. Invest.; 35: No. 4, 323-330(Jul 1975).

A method for estimating total bone calcium is reported. The method is based on two-dimensional scanning photon absorptiometry on the distal part of the forearm. The following factors are investigated: precision of measurements on standards and human subjects; linearity; the effect of varying bone orientation; amount of fat and soft tissue; and the relation between weight and concentration of calcium and phosphate. The results show that the method is eminently suitable for rapid, easy and atraumatic measurement of local bone calcium in vivo. (auth)

**11461** X-RAY SPECTRAL FLUORESCENCE ANALYSIS OF RADIOACTIVE ELEMENTS. Lenin, S. S.; Serikov, I. V.; Toporskii, V. N. pp 250-252 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian).

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The principles of the method, the general sensitivity of the apparatus, and the applicability of this method to U and Th are described. (tr-auth)

**11462** LABORATORY ANALYSIS OF URANIUM, THORIUM, AND POTASSIUM IN ROCKS BY GAMMA SPECTROMETRIC METHODS. Bobrov, V. A.; Gofman, A. M.; Krendelev, F. P. pp 252-260 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian).

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

An analysis is given of the $\gamma$ radiation of the elements in U and Th ores. The improved operation of the analytical installations is described. The singularities in the analysis on one- and multichannel spectrometers and the sensitivity thresholds are characterized. The applicability of $\gamma$ spectrometric methods for geochemical studies is shown. (tr-auth)

**11463** INVESTIGATION OF ROCKS BY THE METHOD OF SCINTILLATION LOW-BACKGROUND GAMMA SPECTROMETRY. Surkov, Yu. A.; Sobornov, O. P.; Fedoseev, G. A. pp 260-266 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian).

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The results of a methodical study of different geometric variants during $\gamma$ spectrometric measurements are reported. The operating regimes of a spectrometer with and without shields are analyzed. The optimum determination conditions are given. Methods for the preparation of standards are described. (tr-auth)

**11464** APPLICATION OF DISPERSIVE X-RAY SPECTROMETRY TO THE INTERFACE ANALYSIS OF METALS WELDED BY EXPLOSION. Perelstein, P.; Zichy, J. (Ministere des Armees, Centre de Recherches du Bouchet, 91 (France)). Qual., Rev. Prat. Contr. Ind.; No. 71, 29-37(Feb 1975). (In French).

An example of application (interface analysis of metals welded by explosion) shows the analytical possibilities offered by a dispersive x-ray spectrometer used conjointly with a scanning electron microscope. (FR)

**11465** DETERMINATION OF URANIUM IN STEEL. Kysil, B. (Vyzkumny a Zkusebni Ustav SONP Kladno (Czechoslovakia)). Hutn. Listy; 29: No. 10, 735-738(10 Oct 1974). (In Czech).

A photometric method of determining uranium in all types of steel is described. Uranium(VI) is separated from interfering elements by silica gel chromatography and is photometered using arsenazo III. (INIS)

**11466** INFRARED SPECTROSCOPY AT THE INSTITUTE OF NUCLEAR RESEARCH. Moravec, J.; Sara, V. Nukleon; No. 2, 46-50(Sep 1974). (In Czech).

Applications are discussed of infrared spectroscopy in various tasks, such as analyses of heavy water, of an extraction agent from reprocessing of irradiated fuel, and of hexafluorides, studies into the sol-gel method, uranates, selective sorbents. Principal spectroscopic data used and the results obtained are given. (auth)

**11467** PHOTOMETRIC DETERMINATION OF NIOBIUM IN ZIRCONIUM ALLOYS USING PAR. Slama, J. (Statni Vyzkumny Ustav Materialu, Prague (Czechoslovakia)). Hutn. Listy; 29: No. 10, 738-739(10 Oct 1974). (In Czech).

The direct photometric determination of niobium in zirconium alloys using 4-(2-pyridylazo)-resorcinol (PAR) is described. A pH-meter was used in the adjustment of pH of the solutions prior to staining. (INIS)

## *Radiometric and Radiochemical Procedures*

*Refer also to abstracts 12078 and 12112.*

**11468** (BARC-824) DETERMINATION OF PLUTONIUM-238 IN PLUTONIUM BY ALPHA SPECTROMETRY. Aggarwal, S. K.; Jain, H. C.; Mathews, C. K.; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). 1975. 21p. Dep. NTIS (US Sales Only) $4.50.

A method is presented for the determination of $^{238}Pu$ in plutonium samples by alpha spectrometry. Various factors contributing to the energy degradation, a problem usually encountered in alpha spectrometry, are discussed. A computer program is given for the evaluation of peak areas when the alpha spectrum is degraded. The results are compared with those obtained by mass spectrometry. (auth)

**11469** (CONF-741040-P1, pp 139-147) AEROSOL COMPOSITION STUDIES USING ACCELERATOR PROTON BOMBARDMENT. Nelson, J. W.; Winchester, J. W.; Akselsson, R. (Florida State Univ., Tallahassee). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

The proton beam of the Florida State University Tandem Van de Graaff Accelerator is being used to make quantitative determinations of the composition of particulate matter found in the atmosphere. Proton scattering using 16 MeV incident particle energy is employed to resolve the light elements (up to Cl), while elements Al and heavier are observed via proton induced x-ray emission analysis. In order to realize advantages of these proton excited analyses, specialized techniques are used, such as the use of uniform beams which entirely cover the area of targets of nonuniform areal density. Also, specialized air sampling equipment was built to take advantage of the small size of samples required for proton-induced analyses. The multielement character, ease of automation, and short time (several minutes) needed for analysis make these techniques attractive from the standpoint of analysis cost per sample. (auth)

**11470** (CONF-741040-P1, pp 148-156) ENVIRONMENTAL ASPECTS OF ION-INDUCED X-RAY EMISSION BY INFINITELY THICK TARGETS. Van Rinsvelt, H. A.; Dunnam, F. E.; Russell, J. P.; Bolch, W. E. (Univ. of Florida, Gainesville). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Elemental analysis through proton and alpha particle induced x-ray emission by infinitely thick samples of environmental interest was found to be feasible. A quantization technique using internal standards and the optimization of the beam energy for optimal sensitivity were investigated. The average limit of detection ranges from about 0.1 ppM for calcium to 1 ppM for strontium. (auth)

**11471** (CONF-741040-P1, pp 157-162) TRACE ELEMENT STUDIES AT UNIVERSITY OF PITTSBURGH. Cohen, B. L.; Chan, K. C.; Shabason, L.; Wedberg, G.; Rudolph, H. (Univ. of Pittsburgh). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Seven areas of research are discussed. A method was developed for analyzing samples for their major constituent elements by irradiating with protons and detecting prompt gamma rays, mostly produced in (p,p'gamma) reactions. Among other applications, the method was used to analyze air particulates for C, N, O, Al, Si, S, Co, and Fe. Trace element analysis by proton or alpha particle induced x-ray fluorescence was used on thin samples in a study of the variations of Pb, Br, Fe, and Zn in air particulates as a function of time. Among other applications this method was also used in studying trace elements in rainwater. An x-ray fluorescence method that is effective in the analysis of thick samples was developed. A method based on measuring energies of elastically scattered protons was developed for the analysis of light elements. The use of proton and neutron activation analyses, as well as methods for studying depth profiles for hydrogen and helium in materials are discussed. (JGB)

**11472** (CONF-741040-P1, pp 163-172) POTPOURRI OF PROTON INDUCED X-RAY EMISSION ANALYSES. Mangelson, N. F.; Nielson, K. K.; Eatough, D. J.; Hansen, L. D. (Brigham Young Univ., Provo, UT). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

A proton-induced x-ray emission analysis (PIXE) system using 2-MeV protons was developed. Measurements are being made in connection with several research projects. A study is being conducted to provide ecological baseline information in the region of the Navajo and the proposed Kaiparowits coal-fired electric generating stations. Trace-element measurements in this study are reported on air-particulate samples, small rodent tissues, soils, and plants. In another study air particulates collected near a source of $SO_2$ are extracted from the collection filter with an HCl solution and sulfate and sulfite ions are determined by calorimetric methods. The extraction solution is also analyzed by PIXE to determine the elemental composition. The latter information is necessary for an understanding of possible interferences with the calorimetric method and also indicates the heavy metals emitted by the source. Studies on human autopsy tissues, archeological artifacts, and in regular graduate and undergraduate laboratory classes are mentioned briefly. (auth)

**11473** (CONF-741040-P1, pp 173-183) TRACE ELEMENT CONTENT AND DEPTH DISTRIBUTION USING PROTON AND DEUTERON INTERACTIONS. Mandler, J. W.; Semmler, R. A. (IIT Research Inst., Chicago). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

The application of proton and deuteron beams from a 2 MeV Van de Graaff accelerator to problems of chemical analysis is described. Typical applications, because of the short range particle, involving surface or skin analysis, residues, thin deposits, or plating. Both atomic and nuclear interactions are used to provide detection capability for heavy elements as well as light elements down to lithium. Examples are given of the use of resonance reactions to obtain concentration profiles with depth. They include examination of the Al component of a metal alloy (Fe-25Cr-4Al-0.4Y) before and after heat treatments and fluorine concentration profiles of three treated teeth. (JGB)

**11474** (CONF-741040-P1, pp 184-188) ALPHA EXCITATION FOR MONITORING AEROSOLS IN CALIFORNIA. Cahill, T. A. (Univ. of California, Davis). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Accelerator-produced alpha particle beams are presently the most commonly used analytical tool for examining California's aerosols by size and elemental composition. The design of sampling methods compatible with both ion-excited x-rays emission and ion elastic scattering has allowed information to be obtained on the total spectrum of aerosol elemental composition, hydrogen through uranium, at up to 15 sites on a continuous basis. This allows comparison with gravimetric values obtained from more conventional aerosol sampling methods, while allowing detailed information to be generated on aerosol sources, trans-

port, transformation, and sinks. This program has been able to be instituted largely because of the low cost per analysis (positive elemental identifications at approximately $0.20 a piece) possible because of automation and large throughput of samples. (auth)

**11475** (CONF-741040-P1, pp 189-202) TRACE ELEMENT STUDIES IN BIOENVIRONMENTAL SAMPLES USING 3-MeV PROTONS. Walter, R. L. (Duke Univ., Durham, NC); Willis, R. D.; Gutknecht, W. F. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Trace metal compositions of a wide range of biological, environmental, medical and clinical samples were investigated using proton-induced x-ray emission analysis (PIXEA). The x-rays were detected with a Si(Li) detector and spectra from over 3000 irradiations have been recorded on magnetic tape. The $chi^2$ fitting code TRACE developed at our laboratory was used in a semi-automatic mode to extract abundances of elements from S to Cd. Various methods of overcoming analytical problems and specimen preparation difficulties are reported. Results from some samples for typical studies are illustrated along with the reasons for interest in the sample types. (auth)

**11476** (CONF-741040-P1, pp 203-208) LINEAR SCANS OF HAIR STRANDS FOR TRACE ELEMENTS BY PROTON INDUCED X-RAY EMISSION. Jolly, R. K.; Pehrson, G. R.; Gupta, S. K.; Buckle, D. C.; Aceto, H. Jr. (College of William and Mary, Newport News, VA). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Hair strands obtained from school children in the 10 to 12 year age group were analyzed for trace element concentration as a function of distance from the root by proton-induced x-ray emission to study the history of exposure of the donors to toxic trace metals. These samples were collected from the vicinity of a copper smelter where high levels of As, Cd, Sb, and Pb have been noted. Scans show a continual build-up of Pb as a function of distance from the root, while As shows a reproducible and distinct maximum approximately 10 cm from the root. The concentration of Zn was found to be constant in all samples (without exception) to within the uncertainties of our measurements. (auth)

**11477** (CONF-741040-P1, pp 322-326) APPLICATIONS OF SMALL ACCELERATORS IN ENVIRONMENTAL SCIENCE. Kliwer, J. K. (Univ. of Nevada, Reno). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

The use of small accelerators in trace element analyses, as applied to environmental science education at the undergraduate level, is discussed. A 2-MeV Van de Graaff accelerator and a converted neutron generator, operating from 100 to 150 kV are used to accelerate protons for the purpose of exciting inner-shell vacancies, and the subsequent characteristic x-rays are observed with a lithium drifted silicon detector. While the higher energy machine is appropriate for thin targets, the lower energy protons from the neutron generator have been used with both thick and thin targets. Spectra from air and water samples are displayed, and the data are interpreted with respect to the regional area or the conditions under which the samples were collected. (JGB)

**11478** (CONF-741040-P1, pp 327-335) APPLICATIONS OF CHARGED PARTICLE INDUCED X-RAY ANALYSIS TO FORENSIC AND BIOLOGICAL STUDIES. Barnes, B. K.; Beghian, L. E.; Kegel, G. H. R.; Mathur, S. C.; Mittler, A.; Quinn, P. W. (Univ. of Lowell, MA). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

X-ray emission analysis was applied to the analysis of firearm discharge residues on hands for trace elements. It was also applied to the determination of trace element concentrations in the blood of malaria-infected and healthy mice. (JGB)

**11479** (HW-44922) AUTORADIOGRAPHIC ANALYSIS OF PLUTONIUM DEPOSITION IN HUMAN SKIN. Dockum, N. L.; Case, A. C. (Hanford Works, Richland, Wash. (USA)). 23 Aug 1956. 7p. Dep. NTIS $4.50.

A human skin biopsy known to contain a quantity of plutonium was submitted for autoradiographic analysis. The deposition of the plutonium may have occurred following puncture of the dorsum of the skin in the area between the right thumb and index finger. The puncture occurred on February 28, 1952 and the skin was excised on July 31, 1956. A description is given of the autoradiographic technique employed to locate the site of deposition, the nature of the plutonium (particulate or diffuse), and the quantity of plutonium found as determined by radioanalysis of the skin biopsy. (auth)

**11480** (JAERI-M-5947) STANDARD SPECTRUM METHOD FOR ANALYSIS OF A GAMMA-RAY SPECTRUM AND ITS APPLICATION TO AN IRRADIATED FUEL. Tasaka, K. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 285p. (In Japanese). INIS.

The standard spectrum method has been developed for accurate analysis of a complicated gamma-ray spectrum. The method analyzes the observed gamma-ray spectrum by the least-square method, using a standard spectrum for expressing the line shape and a linear function for the background continuum. The standard spectrum is derived directly from the observed spectrum of a single photopeak by subtracting the background and smoothing the data. The line shape is expressed accurately by the standard spectrum with a minimum number of parameters; this makes it possible to analyze overlapping peaks accurately with little computer time. Applicability of the method is examined extensively. It is then applied to analysis of the complicated gamma-ray spectrum of an irradiated fuel to obtain its burnup and irradiation history and the neutron capture rate of $^{238}U$. (auth)

**11481** METHOD FOR THE ANALYSIS OF ACTIVE AND NON-ACTIVE SULFUR IN METALLURGICAL SAMPLES BY MEANS OF A SINGLE PROPORTIONAL COUNTER. Wezranowski, E.; Ricouard, J. P.; Kalicki, A. (Inst. of Nuclear Research, Varsovie, Poland). Radiochem. Radioanal. Lett.; 23: No. 2, 79-83(20 Oct 1975). (In French)

A method of simultaneous quantitative determination of non-active and active ($^{35}S$) sulfur has been elaborated. The samples were prepared from metallurgical materials (steel, pig iron, slag) in the chemical form of CuS. As a detector the window gas flowing proportional counter has been used. The determination of total amount of sulfur has been carried out by use of x-ray fluorescence and the activity of $^{35}S$ has been measured by using $\beta$-analysis. Under the described conditions the minimum detectable quantity of sulfur is 0.6 mg and the minimum detectable activity corresponds to a few nCi. (auth)

**11482** NON-DESTRUCTIVE DETERMINATION OF METALS IN ROCKS BY RADIOISOTOPE X-RAY FLUORESCENCE INSTRUMENTATION. Kunzendorf, H. (Atomenergikommission, Copenhagen). pp 401-414 of Proceedings of the Fourth International Geochemical Exploration Symposium. Jones, M. J. (ed.). London; Institution of Mining and Metallurgy (1973).

From 4th international geochemical exploration symposium; London, Eng. (17 Apr 1972).

Radioisotope x-ray fluorescence instrumentation for rapid and non-destructive determinations of metals in rocks is described. Portable apparatuses have been applied in preliminary studies on alkali syenite outcrops of the Ilimaussaq intrusion, south Greenland, and on an outcropping Mo deposit and a heavy mineral deposit in east Greenland. The instrumentation has also been tested in a small stream-sediment survey in east Greenland. Detection limits found were 0.1% Ti, 0.4%Zr and 0.1%Nb for measurements on cut rock surfaces, and 0.21% Cr, 0.14% Cu, 0.06% Ni, 0.14% Zn, 0.04% Zr, 0.07% Nb, 0.03% Mo, 0.1%Pb and 0.02% La + Ce in pulverized rocks. The application of portable radioisotope x-ray fluorescence instrumentation is proposed for the investigation of mineralized rock outcrops, especially of the disseminated-ore type, which may lead to the estimation of boundaries and grade of the outcropping ore deposit and its surrounding rocks, for the assay of loose boulders, for the semiquantitative analysis of panned heavy mineral concentrates, and for the assay of drill cores and pulverized rock samples. Radioisotope x-ray fluorescence spectrometry, which has detection limits of the order of 10 ppm, can be used for the multi-element analysis of stream-sediment samples, drill cores and pulverized rocks in the laboratory. Preliminary work on a drill-core section is presented. (auth)

**11483** DETERMINATION OF LEAD IN ORE SLURRIES BY GAMMA-RAY ATTENUATION. Churchill, T. R.; Dalton, J. L.; Dibbs, H. P. Scientific Bull. No. CM75-3. Ottawa; Department of Energy, Mines, and Resources (1975). 30p. $0.50.

The preferential attenuation of low-energy $\gamma$ radiation by high atomic number elements was applied to the determination of the Pb content of ore slurries containing up to 50 wt % solids. For ores containing between ~0.16 and 10% Pb, a linear relationship

was found between Pb content and γ attenuation. The determination of the solids content (density) of the slurries, based on the attenuation of high-energy γ radiation, was also investigated, and was found to be effectively independent of the atomic number of the absorber. An equation is given that predicts the effect of changes in density and elemental composition in the slurry on the attenuation of γ radiation. Also, an analysis of the errors in both γ attenuation methods is presented. (Metals Abstr.)

**11484** MOLECULAR BEAM SOLID ANALYSIS. Devienne, F. M.; Diebold, A.; Roustan, J. C. (Nice Univ., 06 (France). Lab. de Physique Moleculaire des Hautes Energies). pp 52-69 of Comptes rendus du 4th symposium international sur les jets moleculaires. Paris, France; Bartheye (1974). (In French).

From 4th international symposium on the molecular beams; Cannes, France (9 Jul 1973).

The chemical composition of every solid may be determined by bombarding with a high energy molecular beam. The solid is placed into a conductive and insulated analysis chamber. This very sensitive method allows the determination of adsorbed atoms or molecules and gives an idea about the binding between atoms groups inside the solid. (FR)

**11485** LIQUID SCINTILLATION COUNTING OF CHLOROPHYLL. Fric, F.; Horickova, B.; Haspel-Horvatovic, E. (Slovenska Akademia Vied, Bratislava). Int. J. Appl. Radiat. Isot.; 26: No. 9, 509-514(Sep 1975).

A precise and reproducible method of liquid scintillation countin was worked out for measuring the radioactivity of $^{14}C$-labelled chlorophyll a and chlorophyll b solutions without previous bleaching. The spurious count rate caused by luminescence of the scintillant-chlorophyll system is eliminated by using a suitable scintillant and by measuring the radioactivity at 4 to 8°C after an appropriate time of dark adaptation. Bleaching of the chlorophyll solutions is necessary only for measuring of very low radioactivity. (auth)

**11486** ESTIMATION OF RARE AND RADIOACTIVE CONSTITUENTS IN SAMPLES OF INDIAN TOBACCO WITH THE AID OF LOW-LEVEL BETA-COUNTER. Purkayastha, B. C.; Bhattacharyya, D. K. (Saha Inst. of Nuclear Physics, Calcutta). J. Radioanal. Chem.; 27: No. 2, 345-351(1975).

The study of the Nicotiana rustica variety from North Bengal, revealed that the respective amounts of radioactive nuclei $^{40}K$, $^{90}Sr$, $^{90}Y$ and rare earth activity as well as $^{210}Pb$ were found to be 4.04, 2.42, 4.52, and 0.052 pCi/g of cured leaves. In another investigation with Nicotiana tabaccum variety from Rajahmundri, Andhra Pradesh, contents of $^{40}K$, $^{90}Sr$, $^{90}Y$ and rare earth activity, and $^{210}Pb$ were observed to be 4.06, 1.02, 3.44, and 0.20 pCi/g of cured leaves, respectively. Results indicate that the amount of polonium which is presumably in equilibrium with RaD in these two varieties of Indian tobacco leaves is very small. Detailed studied on different varieties of Indian tobacco are in progress. (auth)

**11487** CAPABILITIES OF PROTON INDUCED X-RAY FLUORESCENCE IN ANALYTICAL CHEMISTRY. Vis, R. D.; Verheul, H. (Univ., Amsterdam). J. Radioanal. Chem.; 27: No. 2, 447-456(1975).

The possibility to use proton induced X-ray fluorescence in trace analysis is investigated. Sensitivities and detection limits for elements from Z = 24 are determined. The influence of a NaCl matrix on these parameters is measured and some possibilities are given to use the technique in analytical practice. (auth)

**11488** RAPID QUALITATIVE DETERMINATION OF MAIN COMPONENTS IN ARCHAEOLOGICAL SAMPLES BY RADIOISOTOPE-EXCITED X-RAY FLUORESCENCE ANALYSIS. Shenberg, C.; Boazi, M. (Soreq Nuclear Research Center, Yavne, Israel). J. Radioanal. Chem.; 27: No. 2, 457-463(1975).

Archaeological specimens were examined by the radioisotope-excited x-ray method to determine their chemical compositon. Individual K and L x-rays of Fe, Ni, Cu, Zn, Pb, Mo, Ag, In, Sn, Sb, and Ba were induced by using $^{241}Am-I$ and $^{241}Am-Tm$ source-target assemblies. A lithium-drifted silicon diode coupled to a 400-channel analyzer was used for detection. No sample preparation was required and all the elements were measured simultaneously in 40-min counting time. (auth)

## Separation Procedures

**11489** (IFA-RC-9-1974) TEMPERATURE DEPENDENCE IN THE CHROMATOGRAPHIC SEPARATION OF HAFNIUM AND ZIRCONIUM. Arsenie, I. (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 8p. (In French). INIS.

Temperature dependence of the elution of hafnium and zirconium in the sulfate form on anion resin is presented. The tests give evidence of a variation of distribution coefficients with temperature. (tr-auth)

**11490** (IPNO-TS-75-1) SOLVENT EXTRACTION OF THE LANTHANIDES AS THENOYLTRIFLUOROACETONATES FROM THE $LiNO_3-KNO_3$ EUTECTIC. Tanipanichskul, P. (Paris-6 Univ., 75 (France)). 1975. 62p. (In French). Dep. NTIS (US Sales Only) $5.50.

Thesis.

The extraction mechanism at 150°C of the lanthanides by TTA from the fused eutectic $LiNO_3-KNO_3$ in an organic phase of a polyphenyl eutectic was studied. Tracer techniques were used to measure the distribution coefficients D. The variations of D with the total TTA concentration in the organic phase was measured for all the lanthanides and with the partial pressures of $NO_2$ and $O_2$ in the gaseous phase in contact with the organic and saline phases for Nd, Eu, Gd, and Yb. For the light lanthanides from La to Sm the formation of negatively charged chelates, soluble in the mineral phase, was observed and D passes through a maximum with increase of TTA concentration. For the heavy lanthanides only a neutral chelate is formed and log D increases with the log of the TTA concentration. In both cases the $H^+$ ions released by the formation of the chelates are fixed by oxide ions of the eutectic with production of $NO_2^-$, $O_2$, and $H_2O$. The composition of the complex extracted was determined. It was shown that some lanthanides are better extracted when the partial pressures of $NO_2$ and $O_2$ are low. (JSR)

**11491** DESIGN CRITERIA FOR URANIUM ION EXCHANGE IN A FLUIDIZED SYSTEM. Traut, D. E.; Nichols, I. L.; Seidel, D. C. Paper 75-B-116. New York; Society of Mining Engineers (1975). vp.

A fluidized countercurrent ion-exchange system was developed, operated and evaluated. The system consisted of integrated multiple-compartment absorption and elution columns in which the solution flows are continuous except for short periods when resin increments are withdrawn. The exchange of uranyl sulfate between a simulated acid leach U solution and a strong-base, ion exchange resin, together with the subsequent elution with an acidified sodium chloride solution, was studied. The effects of the number of sections, section heights, amount of resin withdrawal and solution flow rates were investigated. Also examined were the kinetic and equilibrium relationships for the absorption step. The experimental data indicate a strong interdependence between variables. Solution retention time appears to be a major limiting variable. The column was efficient over a range of conditions, but close control was needed for optimum operation. (Metals Abstr.)

**11492** SYNTHESIS AND ION-EXCHANGE PROPERTIES OF ZIRCONIUM ANTIMONATE. Separation of $Hg^{2+}$ from $Zn^{2+}$, $Cd^{2+}$, $Pb^{2+}$, and $Bi^{3+}$; $Ca^{2+}$ from $Mg^{2+}$; $Sr^{2+}$ from $Rb^+$, $Cs^+$, and $Ba^{2+}$; $Ba^{2+}$ from $La^{3+}$; $In^{3+}$ from $Fe^{3+}$, $Ga^{3+}$, and $La^{3+}$; and $Ag^+$ from $Tl^+$. Mathew, J.; Tandon, S. N. (Univ. of Roorkee, India). J. Radionanal. Chem.; 27: No. 2, 315-328(1975).

Samples of zirconium antimonate have been prepared under varying conditions of precipitation. Their properties, composition, and ion-exchange behavior are reported. The lg $K_d$ vs. pH curves are given for $Rb^+$, $Cs^+$, $Zn^{2+}$, $Ca^{2+}$ and $Tl^{3+}$ ions. The distribution coefficients of 26 metal ions have been measured and several separations of analytical and radiochemical importance achieved. (auth)

**11493** INFLUENCE OF ORGANIC SOLVENTS ON THE EXTRACTION OF Th(IV) AND U(VI) WITH SUBSTITUTED SECONDARY, TERTIARY, AND QUATERNARY AMMONIUM NITRATES FROM NITRIC ACID SOLUTIONS. I. Methanol. Schmid, E. R.; Kenndler, E. (Univ., Vienna). J. Radioanal. Chem.; 27: No. 2, 369-382(1975). (In German)

The influence of methanol on the distribution of thorium (IV) and uranium (VI) between aqueous solutions of nitric acid and solutions of Amberlite LA-2, trilaurylamine and Aliquat-336-nitrate has been investigated. The amount of acid in the organic phase increases with increasing concentration of nitric acid and methanol in the aqueous phase. The concentration of acid in the organic phase can be calculated by a given formula for Amberlite LA-2. The distribution of methanol is discussed. The distribution of thorium (IV) and uranium (VI) changes when methanol is added. This is explained by the shift of the equilibrium of the metal complex and by the enhanced extraction of acid. (auth)

**11494** EXTRACTION BEHAVIOR OF THORIUM, PROTACTINIUM, URANIUM, AND NEPTUNIUM FROM MIXED MINERAL ACID SOLUTIONS BY TLA. Souka, N.; Shabana, R.; Hafez, F. (Atomic Energy Establishment, Cairo). J. Radioanal. Chem.; 27: No. 2, 401-410(1975).

Studies on the extraction of thorium, protactinium, uranium and neptunium from $H_2SO_4$ solutions by TLA indicated that these ele-

ments have low distribution coefficients (<0.1) at high acid concentrations. Additions of HCl or HBr to $H_2SO_4$ solutions enhances appreciably the extraction of the mentioned elements. A systematic investigation of the effect of halide concentration and solvent concentration helped in explaining the observed enhancement as well as identifying the extracted complexes. (auth)

# Inorganic, Organic, and Physical Chemistry

**11495** (CONF-7209130-, pp 1-13) INTRODUCTION TO THE STABLE ISOTOPES OF OXYGEN: THEIR PRODUCTION, PROPERTIES, AND USES. Samuel, D. (Weizmann Inst. of Science, Rehovoth, Israel). 1972.

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

A brief review is given of the difficulties in the production of highly enriched oxygen isotopes and of the plant at Rehovot which uses water distillation to produce $^{17}O$ and $^{18}O$ and deuterium-depleted $H_2{}^{16}O$. The methods used for the analysis of oxygen isotopes are summarized. Some new and unusual techniques for using the stable isotopes of oxygen are reviewed. (JSR)

**11496** (UCID-16933) BASIC PRINCIPLES OF CHEMISTRY AND PHYSICAL CHEMISTRY. Colmenares, C. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 13 Oct 1975. Contract W-7405-Eng-48. 242p. Dep. NTIS $7.60.

A course designed to provide communications between the designer of a system such as a mechanical engineer or a physicist and the material scientist such as a chemist or chemical engineer is presented. The topics discussed are stoichiometric principles, behavior of ideal gases, vapor pressure, humidity and saturation, solubility of gases in liquids, diffusion of gases, chemical reaction kinetics, and application of concepts to compatibility problems. The appendix provides problems to be used in conjunction with TV lectures. (JSR)

## *Chemical and Physicochemical Properties*

*Refer also to abstracts 11423, 11583, 11596, and 12075.*

**11497** METHOD FOR PREPARING LIQUID MIXTURES OF ISOMERS OF BIS-PHENOXY-PHENYLE METHANE AND THE MIXTURES THUS OBTAINED. (to Caliqua S. A.). French Patent 2,215,409/A/. 25 Jun 1973. 8p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to a method for preparing a liquid mixture of isomers of bis-phenoxyphenylmethane. That method is characterized in that it comprises the steps of inducing the isomeric change of bis phenoxyphenylmethane in the presence of a Friedel-Crafts catalyst in an aromatic solvent likely to be involved in the transfer reaction, then separating, in known fashion, the thus obtained mixture of bis-phenoxyphenylmethane. The product as obtained can be used as coolant fluid. (FR)

**11498** PREPARATION OF INDOLE DERIVATIVES AS RADIOPROTECTING AGENTS. II. Radiopharmacologic Part. Andrieu, L. (Centre de Recherches du Service de Sante des Armees, Clamart, France); Fatome, M.; Granger, R.; Robbe, Y.; Terol, A. Eur. J. Med. Chem.-Chim. Ther.; 9: No. 4, 453-457 (Jul 1974). (In French).

Well-known activity of heterocyclic compounds such as dithiolane, thiazolidine, or thioamide is not enhanced when these structures are fixed on position 3 of the indole. Hydroxy or methoxy groups fixed on position 5 of the indole seem to increase a satisfactory radioprotecting activity. (FR)

**11499** HIGH-PRESSURE PHASE TRANSFORMATION OF $CaSO_4$ (ANHYDRITE) DURING A NUCLEAR EXPLOSION. Khan, J. S. (Univ. of California, Livermore). Science; 189: No. 4201, 454-455 (8 Aug 1975).

Examination of the postshot cores from the portion of the Tatum Salt Dome that had been subjected to a nuclear explosion (Salmon Event) has indicated evidence for the high-pressure phase transformation of anhydrite. This evidence consists of distinctly different optical domains within the shocked anhydrite. Evidence for the transition exists out to approximately 1.5 cavity radii. Excellent agreement exists between experimental work and the theoretical calculations of the predicted pressure profile. (auth)

## *Isotope Effects*

*Refer also to abstracts 11555 and 12649.*

**11500** (CONF-7209130-) PROCEEDINGS OF AN INTERNATIONAL COLLOQUIUM ON OXYGEN ISOTOPES, CADARACHE, FRANCE, 4-9 SEPTEMBER 1972. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France)). 1972. 249p. (In French and English)

The 26 papers presented at the Conference are compiled. The topics discussed include theoretical, methodological, and technical aspects, applications of oxygen isotopes to the study of reactional mechanisms and in biology, and isotopic effects. Individual abstracts were prepared for 17 of the papers. (JSR)

*For abstracts of individual papers see: 11421-11424, 11449-11453, 11495, 11510-11512, 12044, and 12469-12471.*

**11501** BRILLOUIN SCATTERING IN ICE AND DEUTERATED ICE AS A FUNCTION OF TEMPERATURE. Ermolieff, A. (Inst. Max von Laue, Grenoble, France). Solid State Commun.; 17: No. 8, 1013-1016(15 Oct 1975).

The elastic constants $c_{11}$, $c_{33}$, $c_{44}$ for ordinary ice and $c_{11}$ for $D_2O$ ice between 12 and 250°K are deduced from light scattering Brillouin measurements for sound waves of wavevector $q = 2.35 \times 10^5 cm^{-1}$. A range of temperature is found between 70 and 130°K where the elastic constants display an abnormal behavior. (auth)

**11502** INTERPRETATION OF THE ANOMALOUS ODD-EVEN ISOTOPES IN THE ARC SPECTRA OF MERCURY. Gerstenkorn, S.; Verges, J. (Centre National de la Recherche Scientifique, 91 - Orsay (France). Lab. Aime Cotton). J. Phys. (Paris); 36: No. 6, 481-486(Jun 1975). (In French)

Precise measurements of odd-even relative isotope shifts (of the order of $10^{-3}$), make it possible to determine directly the second order hyperfine interaction of the $^3D_3$ and $^1D_3$ levels and the electronic factors $a_{6s}$, of the 6snd configurations of mercury. For n = 6, the value $a_{6s}$ (6sd) = 1335.5 ± 2mk determined in this way, is in good agreement with the value (1334.9 ± 1.4 mk) given by the analysis of the hyperfine structure alone. For n = 7, $a_{6s}$ (6s7d) = 1347 ± 2 mk; this latter value is close to the limit value of $a_{6s}$ deduced previously from the $(d^{10}6s)^2S_{\frac{1}{2}}$ term of HgII. Consequently, it is possible to interpret the observed anomalies in terms of second order interactions, and it is not necessary, in the case of mercury, to look for a new phenomenon selectively related to the odd isotopes. (FR)

**11503** INFRARED AND RAMAN STUDIES OF AQUEOUS SOLUTIONS OF $BeCl_2$ AT DIFFERENT pH. Bertin, F. (Lyon-1 Univ., 69-Villeurbanne (France)); Derouault, J. (Bordeaux-1 Univ., 33-Talence (France)). C. R. Hebd. Seances Acad. Sci., Ser. C; 280: No. 15, 973-975(21 Apr 1975). (In French).

The infrared and Raman spectra of light and heavy water solutions of $BeCl_2$ were studied at various pH values. The equilibrium between the hydrated and hydrolyzed species is established and the frequencies given. (FR)

**11504** EXPERIMENTAL STUDY OF THE VISCOSITY OF METHANE, ETHYLENE AND THEIR DEUTERATED DERIVATIVES. Timrot, D. L.; Serednitskaya, M. A.; Bespalov, M. S. (Inst. of High Temperatures, Moscow). Dokl. Akad. Nauk SSSR; 220: No. 4, 799-801(1 Feb 1975). (In Russian).

This study reports the precision measurements of the viscosity of $CH_4$, $C_2H_4$, $CD_4$ and $C_2D_4$ in order to investigate the isotopic effect on the viscosity of gases. Measurements were carried out on a quartz viscosimeter operating on the principle of an oscillating disk. Corrections for gas slippage were made. The error was 0.3 to 0.4%. The viscosity as a function of temperature from 22 to 400°C is well described by a polynomial of the form: $\mu \times 10^8$, Newton-sec/$m^2$ = a + bt + $ct^2$. Here t is in °C. Values of a, b, and c are respectively 1037.8, 3.2132 and -0.0013248 for $CH_4$; 1161.8, 3.5941 and -0.0015006 for $CD_4$; 961.3, 3.3120 and -0.0013098 for $C_2H_4$, and 1014.1, 3.6118 and -0.0015891 for $C_2D_4$. Maximum deviation of the experimental data from that calculated by the above polynomial does not exceed 0.1%. The data for methane and ethylene are in good agreement with literature data. Data on deuterated methane and deuterated ethylene are scanty or lacking. (SJR)

**11505** MOLECULAR VIBRATIONS OF ACETYLACETONE AND DEUTERIOACETYLACETONE. II. Infrared Spectra in Polarized Light. Kopteva, T. S.; Gastilovich, E. A.; Pugach, M. I.; Shigorin, D. N. (Physicochemical Inst., Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 3, 340-342(Mar 1975).

Translated from Zh. Fiz. Khim.; 49: No. 3, 582-586(Mar 1975).

The symmetry of the molecular vibrations of acetylacetone in the enolic form has been determined from the dichroism of the infrared absorption bands in the range 500-3400 $cm^{-1}$. (auth)

**11506** USE OF THE ISOTOPE EFFECT IN THE HEAT CAPACITY FOR THE DETERMINATION OF THE PARAMETERS OF THE CELL POTENTIAL IN OCCLUSION COMPOUNDS. Malyavskii, N. I.; Parbuzin, V. S. (Moscow State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 3, 372-373(Mar 1975).

Translated from Zh. Fiz. Khim.; 49: No. 3, 642-644(Mar 1975).

A convenient method is proposed for the estimation of the parameters of the cell potential for monatomic species distributed in the matrix, which is based on the measurement of the differences between the heat capacities ($\Delta C_V$) of the two isotopic varieties of the incorporated atoms. It is assumed that the cell potential is described fairly satisfactorily by the three-dimensional isotropic Pöschl-Teller potential. (auth)

**11507** THERMAL ISOTOPE EFFECTS IN THE MASS SPECTRA OF BENZENE AND HEXADEUTEROBENZENE. Novosel'tsev, A. M.; Komarov, V. N. (Physicochemical Scientific Research Inst., Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 42: No. 9, 288-289(Feb 1975).

Translated from Zh. Fiz. Khim.; 49: No. 2, 500-501(Feb 1975).

The change in the thermal intensity coefficients of the ions in the mass spectra of $C_6H_6$ and $C_6D_6$ caused by replacement of protium by deuterium has been investigated between 230 and 850°C. (auth)

**11508** ISOTOPE EFFECT IN LIQUIDS AS SHOWN BY TRACER DIFFUSION AT 25°C OF SEVERAL LABELED BENZENES IN BENZENE, CHLOROBENZENE, N-OCTANE, AND CYCLOHEXANE, AND THE RELATIONSHIP TO THE ISOTOPE EFFECT IN SOLIDS. Shankland, I. R. (Adelaide Univ.); Dunlop, P. J.; Barr, L. W. Phys. Rev.; 12B: No. 6, 2249-2252(15 Sep 1975).

Mutual and tracer diffusion coefficients at 25°C are reported for the liquid systems perdeuterobenzene ($C_6D_6$)-chlorobenzene, benzene ($C_6H_6$)-chlorobenzene, $C_6D_6$-n-octane, $C_6H_6$-n-octane, $C_6D_6$-cyclohexane, and $C_6H_6$-cyclohexane. These data are compared with similar data previously obtained in this laboratory. All the data indicate a very slight isotope effect for tracer diffusion of benzene in benzene, in chlorobenzene, in n-octane, and in cyclohexane. Application to the above data of the equation usually used to describe the "isotope effect" in solids, indicates that diffusion in these systems may be governed to a large extent by the viscosity of the solvent. (auth)

## *Isotope Exchange and Isotope Separation*

*Refer also to abstracts 11422 and 12470.*

**11509** (AECL-5250) PULSE ADSORPTION SYSTEM FOR THE MEASUREMENT OF HYDROGEN CHEMISORPTION ON SUPPORTED PLATINUM CATALYSTS. Cassidy, R. M.; Faught, P. L. J.; Stevens, W. H. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Sep 1975. 22p. Dep. NTIS (US Sales Only) $4.50. AECL $1.00.

Pulse adsorption has been studied for the measurement of hydrogen chemisorption on supported platinum catalysts. Experimental parameters have been optimized to permit rapid and reproducible (sigma equals 1.7 percent) determination of chemisorbed hydrogen on Pt-carbon, Pt-$Al_2O_3$ and temperature-sensitive Teflon-treated platinum-carbon catalysts. (auth)

**11510** (CONF-7209130-, pp 95-98) SYNTHESIS OF SOME COMPOUNDS ENRICHED IN $^{17}O$ AND $^{18}O$. Wassermann, I. (Weizmann Inst. of Science, Rehovoth, Israel). 1972. (In French)

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

Three examples of the labelling of compounds with $^{17}O$ and $^{18}O$ are discussed in order to show the utility of the method used or to illustrate the great difficulty in the preparation of materials labelled with oxygen isotopes. The three examples used are $^{17}O$-methanol, $^{17}O$-glacial acetic acid, and $Al_2O_3$ labelled with either isotope. For methanol synthesis the best method is the hydrolysis of trimethylphosphate with $H_2{}^{17}O$ in alkaline medium. The difficulties in the preparation of glacial acetic acid led to the development of a two stage process: isotopic exchange between malonic acid and water enriched in $^{17}O$, followed by the thermal decomposition of malonic acid at 200°C. The synthesis of $Al_2O_3$ labelled with either isotope is quite difficult and both attack of Al foils with labelled water in the presence of mercuric chloride and isotopic exchange between $Al_2O_3$ and $H_2{}^{18}O$ have been used. The difficulties in the analysis of the alumina after labelling is also stressed. (JSR)

**11511** (CONF-7209130-, pp 125-129) ISOTOPIC EXCHANGE AS A TOOL FOR STUDYING RADIATION CATALYSIS. Antoshin, G. V. (Inst. of Organic Chemistry, Moscow). 1972.

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

The isotopic exchange of typical insulators such as $Al_2O_3$, MgO, rare earth oxides and $SiO_2$ and of typical n- and p-type semiconductors under the effects of $\gamma$ irradiation was studied. It was found that irradiation induced the isotopic exchange in most insulators and n-semiconductors. The rate of isotopic exchange was roughly proportional to the dose rates and temperature decrease increased the exchange rate. The G values of the exchange were estimated and a possible mechanism to explain their high values was proposed. p-semiconductors are less sensitive to irradiation than n-semiconductors or insulators. The introduction of impurities to silica, which had a very low sensitivity, increased the activity by two orders of magnitude. Stability after irradiation and the width of the forbidden bands of the oxides were correlated and no radiation catalytic effect was observed for oxides with forbidden bands less than 2 eV. The kinetics of thermal annealing were also determined. (JSR)

**11512** (CONF-7209130-, pp 130-137) ISOTOPIC EXCHANGE BETWEEN $CO_2$ AND $H_2O$ IN HETEROGENEOUS SYSTEMS. Gerster, R. (CEN, Cadarache, France). 1972. (In French)

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

An unsophisticated mathematical pattern has been applied to the accurate study of $^{18}O$ exchange reactions between carbon dioxide and water in heterogeneous systems. From the variations of the isotopic content of highly labelled $CO_2$ introduced in the gaseous phase, one can calculate the diffusion flow between phases and the rate of $CO_2$ hydration. This method has been applied to the study of systems of increasing complexity : aqueous solutions, algae suspensions and aerial leaves of higher plants. (auth)

**11513** (IS-T-704) REACTIONS OF SIGMA-BONDED ORGANOCHROMIUM(III) COMPLEXES. Leslie, J. P. II. (Ames Lab., Iowa (USA)). Dec 1975. Contract W-7405-eng-82. 205p. Dep. NTIS $8.75.

Thesis.

Three projects were carried out, each dealing with the kinetics and mechanism of reactions of sigma-bonded organochromium(III) complexes of the form $(H_2O)_5CrR^{2+}$. Part I describes the kinetics of the reaction of dichloromethylchromium(III) ion with chromium(II) ion in aqueous acid. Part II deals with the radioexchange of 4-pyridinomethylchromium(III) ion with $^{51}Cr^{2+}$ and the kinetics of formation of the organochromium species at 55° in 1 M $H^+$. Part III deals with the reactions of $Hg^{2+}$ and $CH_3Hg^+$ with a series of $(H_2O)_5CrR^{2+}$ complexes, in which R is an aliphatic alkyl group, a haloalkyl group, or an aralkyl group. (LK)

**11514** (LA-tr-75-40) SELECTIVE DISSOCIATION INDUCED BY ABSORPTION OF STRONG INFRARED RADIATION IN WEAK COMBINATION BANDS OF POLYATOMIC MOLECULES. Ambartsumian, R. V.; Gorokhov, Yu. A.; Letokhov, V. S.; Makarov, G. N.; Puretskii, A. A. Translated by A. D. Cernicek from Zh. Eksp. Teor. Fiz., Pis'ma Red.; No. 22, 374-377(1975). 12p. Dep. NTIS $4.50.

Dissociation and isotope separation of the $SF_6$ and $CCl_4$ molecules by the action of strong infrared radiation on a variety of combination bands is investigated. The rate of dissociation is shown to be proportional to the dipole moment of the excited vibration. (auth)

**11515** (LA-tr-75-41) LASER STIMULATED CHEMICAL REACTIONS AND ISOTOPE SEPARATION. Basov, N. G.; Belenov, E. M.; Isakov, V. A.; Markin, E. P.; Orevskii, A. N.; Romanenko, V. I.; Ferapontov, N. B. Translated by A. D. Cernicek from Kvantovaya Elektron. (Moscow); 2: 938-945(1975). 27p. Dep. NTIS $5.00.

This study examines a method of isotope separation in chemical reactions stimulated by laser excitation in the infrared range. It is shown that anharmonicity of molecular vibration exerts practically no effect on the coefficient of isotope separation. Nitrogen isotope separation in a laser-stimulated reaction $N_2 + O_2$ yields 2NO is obtained. The reaction was stimulated in a vessel containing air by simultaneous excitation from Ruby OKG and from an intensive Stokes component obtained with VKR in liquid nitrogen. (auth)

**11516** (UCRL-Trans-10738) STUDY OF THE PHOTOCHEMICAL OXIDATION OF MERCURY: APPLICATION TO THE SEPARATION OF MERCURY ISOTOPES. Morand, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France)). Mar 1974. Translation of CEA-R-4126. 95p. Dep. NTIS $6.00.

Investigation of the mechanism of the isotopic photo-oxidation of mercury has enabled the existence of an unstable excited complex

($HgO_2$*) to be demonstrated. In the presence of butadiene, this complex gives stable mercuric oxide. Butadiene does not act purely as an interceptor for oxidizing species. By theoretical investigation of the complex $HgO_2$*, its electronic structure ($^3$PI) could be determined and its energy of formation (4.6 eV) predicted. The phenomenon of photodecomposition of mercuric oxide was demonstrated and its importance evaluated. The results obtained made it possible to develop an apparatus for the photochemical separation of the isotopes of mercury, whose efficiency is acceptable despite the low quantum yield. Since the method for the photochemical separation of the isotopes has only been studied for mercury, an identical study for other elements, and particularly for elements of the same group as mercury (zinc, cadmium), could lead in the future to new aspects in the study of photochemical mechanisms. (auth)

**11517** (UCRL-Trans-10962) PROCEDURE FOR ISOTOPIC SEPARATION. Petschek, H. Nov 1975. Translation of Belgian Patent 807,117. 19p. Dep. NTIS $4.50.

A procedure and apparatus are described for isotopic separation. The method, which is based on the selective ionization of an isotope by a laser beam in a medium that contains several isotopes, is applied to the separation of $^{235}$U and $^{238}$U. (JGB)

**11518** SULPHUR ISOTOPE GEOCHEMISTRY OF CARBONATITES. Mitchell, R. H. (Lakehead Univ., Thunder Bay, Ont.); Krouse, H. R. Geochim. Cosmochim. Acta; 39: No. 11, 1505-1513(Nov 1975).

Sulphur isotopic data for sulphides and barite from several carbonatites (Mountain Pass, Oka, Magnet Cove, Bearpaw Mountains, Phalabora) show that individual carbonatites have different mean sulphide or barite isotopic compositions which deviate from the meteoritic mean $\delta^{34}S(‰)$. Classification of carbonatites in terms of T, $fO_2$, and pH during formation of the sulphur-bearing assemblages indicates that with decreasing T and increasing relative $fO_2$ the mean $\delta^{34}S$ sulphide becomes increasing negative relative to the mean magma $\delta^{34}S$. Only barite-free high temperature carbonatites (Phalabora) in which the mean $\delta^{34}S$ sulphide approaches the mean magma $\delta^{34}S$ as a consequence of the paucity of oxidized anionic sulphur species in the magma can be used to directly estimate the mean isotopic composition of the source material. Barites from the Mountain Pass carbonatite show an increase in $\delta^{34}S$ with sequence of intrusion of the carbonatite units; dolomitic carbonatite (mean $\delta^{34}S$, + 5.4‰), calcitic carbonatite (+ 4.8‰), silicified carbonatite (+ 6.9‰), tabular carbonatite dikes (+ 8.7‰), mineralized shear zones (+ 9.5‰). Within each of these units a spread of 6 to 8‰ is evident. Isotopic trends in this low temperature (300°C) carbonatite are evaluated by treating the system as a hydrothermal fluid. The observed isotopic variations can be explained by removal of large amounts of sulphur from a fluid whose mean $\delta^{34}S$ is O to + 1‰. (auth)

**11519** METHOD OF ELECTROSTATIC FILTRATION. Devienne, F. M. (to Agence Nationale de Valorisation de la Recherche Anvar). US Patent 3,916,188. 28 Oct 1975. Priority date 26 Jan 1973, France. 10p.

Electrostatic filtration of secondary ions of mass m in a given mass ratio with a primary ion of mass M which has formed the secondary ions by fission is carried out by a method which consists in forming a singly-charged primary ion of the substance having a molecular mass M and extracting the ion at a voltage $V_1$ with respect to ground. The primary ion crosses a potential barrier $V_2$, in producing the dissociation of the ion into at least two fragments of secondary ions and in extracting the fragment ion of mass m at a voltage $V_2$. Filtration is carried out in an electrostatic analyzer through which only the ions of energy eV'' are permitted to pass, detecting the ions which have been filtered. The mass m of the ions is such that (M/m) equals $(V_1 - V_2)/(V'' - V_2)$. (auth)

**11520** STABLE-ISOTOPE COMPOSITION OF THE WATER OF APPLE JUICE. Bricout, J. (Institut de Recherches Appliquees aux Boissons, 93-Montreuil (France)); Merlivat, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Recherche et Analyse); Fontes, J. C. (Paris-6 Univ., 75 (France)). Ind. Aliment. Agric. (Paris); 90: No. 1, 19-22(1973). (In French).

By deuterium and oxygen-18 analysis, it was shown that the water of apples is enriched in heavier isotopes as compared to rain water. The isotopic composition of the water of reconstituted apple juice is close to the isotopic content of the rain water used for dilution. Thus, deterium and oxygen-18 analysis allows a good analytical distinction between natural apple juice and reconstituted juices. (FR)

**11521** APPLICATION OF SPECTRAL ISOTOPE METHOD TO THE STUDY OF THE EXCHANGE OF HYDROGEN ISOTOPES ON HYDROXIDES AND SULFIDES OF SOME METALS. Molochnova, V. A.; Nemets, V. M.; Nikitin, M. K.; Yakimova, V. Ya. Vestn. Leningr. Univ., Fiz., Khim.; No. 1, 56-58(Feb 1975). (In Russian)

Investigations were carried out aimed at clearing up a possible mechanism of processes leading to significant variations of natural content of deuterium oxide. A notable influence of sulfides of a number of metals and some natural samples on isotope composition of contacting water was observed. (auth)

### Feed Materials Processing

**11522** (INIS-mf-1744) EXPERIMENTAL OBTENTION OF THE DESIGN PARAMETERS OF ONE FLUIDIZED BED. Ruiz M, J. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Quimica). 1974. 227p. (In Spanish). INIS.

The object of this study is to obtain experimentally some of the design characteristics of a fluidized bed for the reduction of $UO_3$ to $UO_2$. The variables studied were minimum fluidization velocity, total fluidization velocity, bed porosity, modified friction factor, and sphericity. The fluidized material was $UO_3$ and $UO_2$ with particle size from 840 to 104μ for $UO_3$ and 380 to 74μ for $UO_2$. Equations were obtained which correlate the minimum fluidization velocity and the total fluidization velocity as a function of the mean diameter of the particles. Four arrangements of the bed were studied: packed, loose, and with horizontal or vertical vibration to assist the fluidization. The variants were the density and sphericity of the material. The effect of vibration was positive. The better results were obtained with horizontal vibration for $UO_3$ from 840 to 420μ and for $UO_2$ from 629 to 255μ, expressed in mean diameter of the particles. In finer material vertical vibration was best. A design was prepared for a continuous experimental fluidized bed reactor for the reduction of $UO_3$ to $UO_2$. (tr-INIS)

**11523** (INR-1457/4/C/B) NATURAL LEACHING OF URANIUM FROM GRANITE ORES. Strzelczuk, H. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 9p. (In Polish). INIS.

The results of the research on the natural leaching of uranium from granite ores, being gathered in an experimental heap in Kowary near Jelenia Góra, are described. These ores have been previously mined in the years 1962-1963, and got vapid in a formed heap. The control of filtrates from the heap was initiated on June 29, 1970. The sampling was done by the Industrial Establishment R-1 and analyses were carried out on the spot, the control tests were effected by the Department of Chemical Technology of the Institute of Nuclear Research in Warsaw. The balance of the atmospheric falls and the quantity of uranium having been leached in the period from June 29, 1970 to July 15, 1972 are presented. During these 24 months 488.1 g of uranium have been recovered by means of the athospheric falls. This amounts to 1.4% of the total of uranium in the heap. (auth)

**11524** (NP-20533) CALCULATED SOLUBILITIES OF SOME URANIUM AND VANADIUM COMPOUNDS IN PURE AND CARBONATED WATERS, AS A FUNCTION OF pH. Mann, A. W. (Commonwealth Scientific and Industrial Research Organization, East Melbourne (Australia). Minerals Research Labs.). Sep 1974. 41p. Dep. NTIS (US Sales Only) $5.25.

Solubilities of uranium and vanadium compounds were calculated as a function of pH in order to elucidate the chemical mechanism for the formation of carnotite. (AT)

**11525** (ORNL-5109) URANIUM TAILINGS BIBLIOGRAPHY. Holoway, C. F.; Goldsmith, W. A.; Eldridge, V. M. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 97p. Dep. NTIS $6.50.

A bibliography containing 1,212 references is presented with its focus on the general problem of reducing human exposure to the radionuclides contained in the tailings from the milling of uranium ore. The references are divided into seven broad categories: uranium tailings pile (problems and perspectives), standards and philosophy, etiology of radiation effects, internal dosimetry and metabolism, environmental transport, background sources of tailings radionuclides, and large-area decontamination. (JSR)

## Radiation Chemistry

*Refer also to abstracts 11511, 12193, 12660, 12661, 12666, 12673, 13452, and 14137.*

**11526** (KURRI-TR-120, pp 2-5) MEASUREMENT OF RADICALS BY ENDOR METHOD. Hatano, H. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

Radicals formed by irradiation were measured by the ENDOR method. The ENDOR method makes it possible to analyze a complicated spectrum which was insufficient to be separated in ESR method in radiochemistry and to determine ultrafine bonding constant precisely. As an application of ENDOR method to radicals irradiated with radiation, Box et al have been studied irradiated histidine hydrochloride, ion formation in irradiated thioglycollic acid by ENDOR method, and irradiated crystals of acetyl-DL-alanine chloride and crystal of glycine hydrochloride irradiated with x-ray by means of ENDOR method. Bohme et al formed dibenzocyclohexadiethyl radical from a single crystal of anthracene by irradiation and studied it by ENDOR. The authors have also made studies using ENDOR by irradiating N-acetylmethionine with gamma rays. As mentioned above, it was suggested that ENDOR would be used freely in a study of radiochemistry as a new effective method in studying radicals formed by irradiation. (JA)

**11527** (KURRI-TR-120, pp 6-10) RADIOCHEMISTRY OF HEAVY IONS-AQUEOUS SOLUTION AND LIQUID ORGANIC COMPOUNDS. Imamura, M.; Matsui, M.; Karasawa, T. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

By using accelerated C, N and O ions, the yields of main products obtained from aqueous solution and two or three liquid organic compounds were measured to large extent of LET. Their dependence on LET was also discussed. Fricke solution was used as aqueous solution and alcohol, tetrohydrofuran (THF) and aliphatic ketones were used as liquid organic compounds. It is established that the yield of oxidized products obtained from Fricke solution by gamma irradiation becomes 15.5. This yield decreased with LET increase of radiation, and its yield became 2.9 for either ion when LET became infinity. The larger the mass of heavy ions is, the bigger the values of the yields are when the values of stopping power are equal. G(H2) was 4.9 to 5.4 in gamma-ray analysis of methanol, but this values decreased with increase of LET and then increased rapidly from around −20ev/A. Dependence of $G(H_2)$ of THF on LET showed simple increase. $G(H_2)$ and G(CO) from liquid aliphatic ketone showed the same tendency in low LET region and showed the maximum value at the point of 50 and −70eV/A, respectively. It is extremely characteristic that separation of ketone into $H_2$ and CO is saturated at these LET. (JA)

**11528** (KURRI-TR-120, pp 16-18) INITIAL EFFECTS OF RADIATION ON BIOCHEMICAL HIGH POLYMER. Oda, N.; Iwanami, S. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

In order to elucidate direct effects of ionizing radiation on enzymes, the initial effects of ionizing radiation on drying enzymes were examined. For this purpose, kinds of initial products and producing rates, and also spatial distribution should be quantitatively examined. In the former examination, the following problems are considered: (1) measurement of various kinds of cross sections excited by charged particles including electrons, and grasp of the process of decay of the excited conditions; (2) size of the cross section of inner shell ionization and Auger effects; (3) examination on probability of process of shake-off; (4) assay of products in the condensation phase to which energy was added; and (5) the importance of adding energy in enzymes excited by factors other than electron. In the latter examination, the target thesis was constituted of the following problems; (1) examination on LET distribution led from obtaining slowing down spectrum; (2) evaluation of the extent of track, by examining energy angle distribution of gamma rays; and (3) examination on statistical fluctuation by adding energy in the minute volume. (JA)

**11529** (KURRI-TR-120, pp 19-21) RADIATION CHEMISTRY OF VITAL SUBSTANCES IN THE AQUEOUS SOLUTION. Taniguchi, H. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

In order to demonstrate the effects of radiation upon the early process and repair mechanism in the living body, the resultant intermediate radical in the reaction of active radicals (hydroxyl radical) and solvated electrons ($e_{aq}^-$) which cause the damage to the solute molecules in the aqueous solution at the time of radiation decomposition, and pyrimidine base such as amino acids and nucleic acids was studied with ESR. The sample in aqueous solution was slowly poured. ESR was determined by irradiating electron in the cavity of ESR spectroscope. Four types of radical ESR spectra were determined from pH values in amino acids. Three types of radical structure were identified in nucleic acids. ESR during pulse radiolysis and ESR during photolysis by uv irradiation were determined by soluting uracil. As a result, pH 8 of radical in the former and pH 1-7 and pH 8-10 of radical in the latter were identified. In addition, it has been noticed that the measurement of ESR spectrum of each radical with the increase of temperature in the solute of amino acids obtaining photo oxidation due to ultraviolet rays and infrared rays in freeze-drying solution of potassium ferrocyanide shows the radiochemical process to stable radical in a room temperature in the early reaction. ESR of radical in chemical reagents was also determined. (JA)

**11530** (KURRI-TR-120, pp 22-27) IONS PRODUCED BY GAMMA IRRADIATION AT 77°K TO ALPHA-AMINO ACID CONTAINING NO SULPHUR. Minegishi, A. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

In order to study the cation radical of α-amino acid, the ESR spectrum of α-aminobutyric acid irradiated at 77°K was analyzed, and the cation radical was identified as $NH_3C(CH_3)_2COO$. The "satellite lines" in the ESR spectrum appeared depending on the hyperfine interaction between unpaired electron and H nucleus of the neighboring molecules. This hyperfine interaction was involved by the increasing unpaired electron density on the neighboring molecules, which was induced by the charge transfer interaction between unpaired electron orbital and C−H bonding. The principal values of g-tensor, hyperfine splittings, configuration in the crystal, and conformation were studied. The cation radical of deuterated L-α-alanine, $ND_3CH(CH_3)_2COO$, and that of deuterated glycine, $ND_3CH_2COO$, were also identified by the same way. These cation radicals were very similar to that of α-aminoisobutyric acid on the point of characteristics, such as g-values for the cation radical indicated by the "satellite line" which appeared overlapping on the signal of anion radical, their configuration in the crystal, their conformation, disappearance of the "satellite line" incidentally to the signal of the anion radical by visible ray irradiation. (JA)

**11531** (NP-20747) X-RAY- AND UV-INDUCED PROCESSES IN FROZEN POLAR SOLUTIONS OF L-TRYPTOPHAN. Moan, J. (Norsk Hydros Institutt for Kreftforskning, Oslo). 1975. 19p. Norsk Hydro's Institute for Cancer Research, Oslo.

Two related categories of problems are dealt with, those concerning ionization processes resulting from x-radiation and uv radiation in aromatic molecules, notably in the amino acid tryptophan, and those concerning the fate of the ejected electron and the cation, their physical properties and reactions. The systems chosen for this study were frozen aqueous solutions which form transparent glasses when cooled to 77°K, in most cases ethylene glycol/water glass. Four experimental methods were applied, ESR spectroscopy, optical absorption spectroscopy, recombination luminescence and photoconductivity. The experimental results are reported in reprints of 13 previously published papers and are correlated and discussed in a preceding section. Future work required to follow up the present work is also discussed. (INIS)

**11532** (ORO-4213-1) RESEARCH AND ENGINEERING STUDIES OF THE RADIATION-INDUCED GAS PHASE GRAFTING OF BUTADIENE TO POLYVINYL CHLORIDE. Smith, T. G.; Silverman, J.; Maaghoul, M.; Block, I.; Higaki, H.; Hamanoue, K.; Shimizu, M. (Maryland Univ., College Park (USA). Dept. of Chemical Engineering). 1973. Contract AT(40-1)-4213. 186p. Dep. NTIS $7.50.

The radiation-induced heterogeneous graft polymerization of butadiene vapor to polyvinyl chloride powder was investigated in a pilot-scale continuous recirculating reactor system. A $^{60}Co$ source provided the gamma radiation field. The effects of processing variables on the kinetics of the graft polymerization, including post-grafting reactions outside the radiation field, were determined. Several mathematical models were developed to simulate the performance of the experimental system and to obtain the conversion histories at different locations in the reactor system. An unsteady state model was shown to represent adequately the experimental conversion histories. (JSR)

**11533** (PUC-TN-17/74) INTERSTITIAL HYDROGEN CENTERS IN PROTON IRRADIATED $CaF_2$ AND $SrF_2$. von der Weid, J. P.; Ribeiro, S. C. (Pontificia Universidade Catolica do Rio de Janeiro (Brazil). Instituto de Fisica). Dec 1974. 15p. INIS.

Pure $CaF_2$ and $SrF_2$ single crystals after irradiation with monoenergetic protons in the range between 0.5 and 2.0 MeV show the typical ESR signal due to the presence of interstitial hydrogen atoms. The saturation of the ESR signal with the proton fluence was measured and a model for explaining the saturation phenomenon is proposed. The profile of the $U_2$ centers distribution in the crystals was measured and based on the model the behavior of $U_2$ centers at high concentrations is discussed. A minimum distance between two $U_2$ centers is proposed. (INIS)

**11534** EXCITON ENERGY TRANSFER AND ITS ROLE IN INHOMOGENEOUS RADIOLYSIS OF ALKALI HALIDE CRYSTALS. Bartczak, W.; Sugier, H. (Technical Univ., Lodz, Poland). Radiochem. Radioanal. Lett.; 23: No. 2, 51-55(20 Oct 1975).

The energy of excitons on (001) surface and in the subsurface layer of KCl and NaCl crystals have been calculated and their role in the inhomogeneous radiolysis of the crystals described. (auth)

**11535** RADIATION-INDUCED POLYMERIZATION OF 2,3-DISUBSTITUTED BUTADIENES IN DEOXYCHOLIC ACID INCLUSION COMPOUNDS. Miyata, M.; Takemoto, K. (Osaka Univ., Japan). J. Polym. Sci., Polym. Lett. Ed.; 13: No. 4, 221-223 (Apr 1975).

The radiopolymerizations of 2,3-dimethyl- and 2,3-dichlorobutadiene included in deoxycholic acid as the host molecule are reported. The polymerizations were carried out in sealed glass vials in a dewar flask by irradiating with gamma-rays from a $^{60}Co$ source. The inclusion compounds with or without a mother liquid were irradiated at -78°C for 5 hr with a dose rate of 2.0 x $10^5$ r/hr. Observations indicated that the polymerization proceeded in the solid state, regardless of the presence or absence of the mother liquid. (LK)

**11536** ACCELERATED RADIATION DEGRADATION OF POLYMERS BY HALOGENATED METHANE. Tagawa, T.; Tsuchida, E.; Shinohara, I.; Hagiwara, M.; Kagiya, T. (Japan Atomic Energy Research Inst., Takasaki). J. Polym. Sci., Polym. Lett. Ed.; 13: No. 5, 287-292(May 1975).

The changes of G values of main-chain scission and structure of polyethylene, polypropylene, polystyrene, and polytetrafluoroethylene irradiated with gamma-ray in the presence of halogenated methane–oxygen mixture are reported. (auth)

**11537** ACTIVATION ENERGY OF RADIATION-INDUCED GRAFTING REACTION IN THE POLYETHYLENE-STYRENE SYSTEM. Imai, M.; Uchibori, S.; Ametani, K.; Shimizu, H. (Tokyo Metropolitan Isotope Research Center). J. Polym. Sci., Polym. Lett. Ed.; 13: No. 5, 299-301(May 1975).

The activation energy of radiation-induced grafting in styrene vapor onto the low density polyethylene by preirradiation method is presented. (auth)

**11538** WATER VAPOR DEPENDENCE OF THE KINETICS OF THE SELF-REACTION OF $HO_2$ IN THE GAS PHASE. Hamilton, E. J. Jr. (Argonne National Lab., IL). J. Chem. Phys.; 63: No. 8, 3682-3683(15 Oct 1975).

Pulse radiolysis experiments which show the previously unrecognized dependence of $k_1$ measurements on the amount of water vapor present are reported. (auth)

**11539** VINYL ESTER RESIN AND PROCESS FOR CURING SAME WITH IONIZING RADIATION IN THE PRESENCE OF AMINES. Mani, I. (to Dow Chemical Co.). US Patent 3,901,779. 26 Aug 1975. Filed date 27 Aug 1973. 8p.

The addition of about 1.5 to 5 weight percent of certain amines to a thermosettable mixture of a nonvolatile vinyl monomer and a polymerizable vinyl ester resin reduces the dosage level of ionizing radiation required to cure the mixture. (auth)

**11540** RADIATION-INITIATED SYNTHESIS OF POLYFLUOROAROMATIC DERIVATIVES OF SILICON UNDER THE ACTION OF ACCELERATED ELECTRONS. Vaks, E. A.; Vainshtein, B. I. (Physicochemical Research Inst., Moscow). J. Gen. Chem. USSR (Engl. Transl.); 45: No. 6, 1289-1295(Jun 1975).

Translated from Zh. Obshch. Khimii; 45: No. 6, 1315-1 (Jun 1975).

It was shown that the vapor-phase radiation-initiated synthesis of polyfluoroaromatic derivatives of silicon from hexafluorobenzene and chloropentafluorobenzene with dichloromethylsilane and with tri-chlorosilane goes in high yield. All the main products and by-products were isolated and identified. It was established that the addition of a silyl radical to the chloropentafluorobenzene molecule goes in the ortho position relative to the chlorine atom. (auth)

**11541** MECHANISMS OF AEROSOL FORMATION FROM $SO_2$. Wood, W. P.; Castleman, A. W. Jr.; Tang, I. N. (Brookhaven National Lab., Upton, NY). J. Aerosol Sci.; 6: No. 5, 367-374 (Sep 1975).

From National air pollution control association meeting; Denver, CO, USA (10 Jun 1974).

Experiments were performed to elucidate some of the mechanisms of important reactions leading to aerosol formation involving $SO_2$. In one series, the rapid generation of a high number density aerosol was effected upon exposing 1 ppM of $SO_2$ to ionizing radiation in the presence of moisture. Subsequent addition of $NH_3$ led to further chemical conversion, the product being identified as $(NH_4)_2SO_4$ by x-ray diffraction. Mass spectrometric studies of the gas phase showed the expected reaction sequence leading to the formation of $H_3O^+$ hydrates and the hydroxyl radical. Additional experiments with an ion trap and appropriate free radical scavengers proved that aerosol formation did not involve an ion-molecule switching reaction; but, rather, the reaction of OH with $SO_2$ was found to be an important initiating step. (auth)

**11542** ELECTRON AS A CHEMICAL ENTITY. Faraday Lecture. Dainton, F. S. (Univ. Grants Committee, London). Chem. Soc. Rev.; 4: No. 3, 323-362(1975).

From chemical society annual congress; London, Eng. (1974).

After an introductory section, the subject is covered in sections, as follows: on "dropping" an electron into a liquid or an amorphous solid; the preparation of solvated and trapped electrons in condensed media; the physical properties of solvated or trapped electrons (the ESR spectrum and cavity structure; the equivalent conductance, mobility, diffusion constant, and Stokes radius of $e_s^-$; the ionic atmosphere relaxation time; the thermodynamic properties of $e_s^-$); spectroscopic and other evidence concerning the cavities (the effects of pressure and temperature on the spectrum; direct evidence for a range of trap sizes for $e_s^-$); the trapping and solvation mechanism; the chemical reactions of $e_s^-$; some applications of our knowledge of $e_s^-$. (UK)

**11543** RADIOSENSITIVITY AND HYDROXYL RADICAL REACTIVITY OF PHOSPHATE ESTERS AS MEASURED BY RADIATION-INDUCED DEPHOSPHORYLATION. Greenstock, C. L.; Shierman, E. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Int. J. Radiat. Biol.; 28: No. 1, 1-12(Jul 1975).

The yields of inorganic phosphate from irradiated phosphate esters of biological interest were measured in the presence of various free-radical scavengers. These studies indicated that hydroxyl radical attack on the phosphate esters accounts for most of this damage. Competition kinetics using different hydroxyl radical scavengers whose reactivities are known were used to estimate the rate-constants for the overall hydroxyl radical reactivities of the phosphate esters. The extent of hydroxyl-radical-induced dephosphorylation was very low for nucleotide derivatives, but high for some sugar and glycerol phosphates, reflecting the probability of hydroxyl radical abstraction at the $\alpha$ or $\beta$ carbon atoms adjacent to the phosphate ester linkage. The hydroxyl radical reactivities of nucleotides, coenzymes, sugar phosphates and phospholipid components were all high (1 to $10 \times 10^9$ $M^{-1}sec^{-1}$), indicating the importance of hydroxyl radical attack in the inactivation of these components in living cells, although not necessarily by dephosphorylation. (auth)

**11544** IN SITU RADIOLYSIS ESR STUDY OF FLAGYL. Ayscough, P. B.; Elliot, A. J.; Salmon, G. A. (Leeds Univ., Eng.). Int. J. Radiat. Biol.; 27: No. 6, 603-604(Jun 1975).

An ESR study was carried out of the reactions of free radicals with metronidazole [1-(2-hydroxyethyl)-2-methyl-5-nitroimidazole]. The radicals were generated by the radiolysis of $N_2O$-saturated aqueous solutions of sodium formate or 2-propanol, whose concentrations were about 100 times that of Flagyl (~$10^{-3}$M). Reactions of the solvated electrons were followed by irradiating deoxygenated solutions containing Flagyl. (UK)

**11545** EFFECT OF RADIOACTIVE RADIATION ON THE INTERACTION OF ROCKS AND MINERALS WITH WATER. Vovk, I. F.; Litovchak, A. V. pp 171-177 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian).

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The results of experimental studies of the changes of redox potential and pH of the water-mineral system and the transfer of the chemical elements from the rocks and minerals to the water under the effect of rays were reported. It was shown that the radiation has a substantial effect on the physical-chemical

conditions in the water in contact with the rocks and minerals. (tr-auth)

**11546** METHOD FOR IMPROVING THE TINCTORIAL FEATURES OF POLYMERS THROUGH AMINATION. Ribart, J.; Rupin, M. (Societe Protex, 92-Levallois-Perret (France)); Gaussens, G.; Lemaire, F. (CEA, 75-Paris (France)). (to Commissariat a l'Energie Atomique; Societe Protex). French Patent 2,214,783/A/. 18 Jan 1973. 15p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to a method for improving the tinctorial features of polymers through amination and to the aminated polymers thus obtained. The method consists in grafting onto the polymer a vinilic monomer. Radioinduced grafting can be carried out. (FR)

**11547** $^{60}Co$-$\gamma$ RADIOLYSIS OF CYSTEINE IN AERATED AND OXYGEN SATURATED 1N-$HClO_4$ SOLUTIONS. Manohar Lal (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.). pp 303-309 of Proceedings of the Chemistry Symposium, Aligarh, December 21-23, 1972. Vol. I. Radioisotope Techniques for Chemical and Biomedical Applications, Nuclear and Radio Chemistry, and Radiation Chemistry. Bombay; Department of Atomic Energy (1974).

From Chemistry symposium; Aligarh, India (21 Dec 1972).

$\gamma$ radiolysis of cysteine (CySH) in aerated and oxygen saturated acidic solutions leads to a chain decomposition of the solute with a corresponding formation of cystine (CyS) and cysteine sulfinic acid (CySOOH). A reaction mechanism to explain the experimental yields is proposed and a rate expression for its radiolytic yield G (-CySH) evaluated. It is found that the calculated and experimental G(-CySH) are in excellent agreement. The rate expressions derived for G(CyS-SCy) and G($H_2O_2$) suggest that they are proportional to $1/I^{\frac{1}{2}}$. The results obtained at various dose rates are in accordance with the rate expressions. (auth)

**11548** RADIATION INDUCED GRAFTING OF ACRYLIC ACID AND METHACRYLIC ACID ONTO POLYESTER (TERYLENE) FIBRES. Rao, K. R.; Rao, M. H.; Moorthy, P. N. (Bhabha Atomic Research Centre, Bombay (India). Chemistry Div.); Charlesby, A. pp 327-332 of Proceedings of the Chemistry Symposium, Aligarh, December 21-23, 1972. Vol. I. Radioisotope Techniques for Chemical and Biomedical Applications, Nuclear and Radio Chemistry, and Radiation Chemistry. Bombay; Department of Atomic Energy (1974).

From Chemistry symposium; Aligarh, India (21 Dec 1972). 6 refs., 3 figures, 1 table.

The radiation-induced grafting of acrylic acid and methacrylic acid onto polyester(terylene) has been carried out. It was observed that while both cupric sulfate and ferrous ammonium sulfate were good scavengers for reducing the homopolymerization in acrylic acid solution and for increasing the grafting efficiency, only copper sulfate was effective with methacrylic acid. The results obtained with various H atom and OH radical scavengers are given and the grafting mechanism is discussed. (auth)

**11549** DEVELOPMENT OF RADIATION TECHNOLOGY IN CZECHOSLOVAKIA. Varga, S. (Slovenska Vysoka Skola Technicka, Bratislava (Czechoslovakia). Chemickotechnologicka Fakulta). Jad. Energ.; 20: No. 10, 334-336(Oct 1974). (In Slovak).

The progress of radiation technology in the past 20 years is described. Main trends of research as well as the number of research laboratories and research workers are cited. The importance of radiation technology for national economy is indicated. (auth)

**11550** RADIATION STABILITY OF VP-K ION EXCHANGER. Tabakova, S. V.; Kiseleva, E. D.; Chmutov, K. V. (Leningrad State Univ.). Russ. J. Phys. Chem. (Engl. Transl.); 42: No. 9, 279-281(Feb 1975).

Translated from Zh. Fiz. Khim.; 49: No. 2, 485-488(Feb 1975).

Exposure of the amphoteric ion-exchanger VP-K to cobalt-60 $\gamma$ rays [dosage $(2-10) \times 10^6$ rad], with its various ion-exchange forms in the air-dry state and swollen in water, shows that the different forms vary in radiation stability. Exposure of the nitrate and copper (II) forms rinsed with water to its pH, in the air-dry state, and in the nitrate form swollen in water causes no marked breakdown of carboxyls or of the macromolecular framework. Exposure of the sodium form in water to the same doses produces a decrease in capacity and an increase in swelling of the exchanger, owing to interaction of the radiolysis products of water with swollen exchanger molecules. (auth)

**11551** RADIATION-INDUCED GRAFTING OF HEXAFLUOROACETONE TO POLYETHYLENE. Clark, C. F. College Park, MD; Univ. of Maryland (1974). 62p. University Microfilms Order No. 75-14,301.

Thesis (Ph. D.).

Although hexafluoroacetone is not polymerized by ionizing radiation, it is shown that gamma irradiation of hexafluoroacetone dissolved in polyethylene films produces a graft with a kinetic chain length of more than 100. The effect of dose rate (0.021 to 3.55 Mrad/hr) and temperature (21 to 53°C) on the graft rates were measured. Also the effect of temperature (21 to 53°) on the postgrafting and on the physical properties of the grafted films were investigated. The first postulated reaction step represents production of secondary alkyl radicals by irradiation. The second step involves the linkage of the monomer to the radical site to form the alkoxy radical. Since it cannot add to another monomer unit, this radical abstracts a hydrogen atom from an adjacent polyethylene chain in the third step. Radical recombination terminates the reaction. At dose rates up to 0.125 Mrad/hr, the grafting was found to proceed linearly with time with a dose rate dependence of 0.73 to 21° and 0.81 at 53°. The reaction is insensitive to increases in dose rate above 0.215 Mrad/hr where diffusivity measurements show the reaction to be diffusion-controlled. The rate of reaction increased 10 percent when the temperature was increased from 21 to 53°C. While there was significant postgrafting at 21°, there was none at 53°C. These results are incompatible with simple steady state graft polymerization kinetics. The deviations arise from an observed increase in monomer solubility in the film with increasing graft, and the presence of a radical-scavenging impurity which terminates the kinetic chain with the appearance of a relatively stable radical. EPR data suggests that the impurity is a trace of oxygen which may be produced radiolytically. (Diss. Abstr. Int., B)

**11552** ESR STUDIES ON FUNDAMENTAL PROCESSES IN RADIATION CHEMISTRY AT LOW TEMPERATURES. Part 1. Photobleaching of Trapped Electrons in 8 M NaOH Glass at Temperatures 67 to 173°K. Kroh, J.; Plonka, A. (Technical Univ., Lodz, Poland). Nukleonika; 20: No. 6, 527-539(1975).

Trapped electrons produced by $\gamma$-irradiation at the upper limit of the temperature range under investigation decay upon photobleaching with a positive value of the apparent activation energy while those produced by $\gamma$-irradiation at the lower limit of the same temperature range decay under the same experimental conditions with a negative value of the apparent activation energy. Thus upon photobleaching the trapped electrons seem to be released from the traps without the vertical transition through the conduction band. The apparent quantum yield for photobleaching depends mainly on the actual conditions of the given matrix, i.e. on the relaxation processes proceeding in the matrix. (auth)

**11553** MECHANISM OF RADIOTHERMOLUMINESCENCE OF ALIPHATIC KETONES. Kroh, J.; Wypych, M. (Technical Univ., Lodz, Poland). Nukleonika; 20: No. 6, 519-526(1975).

Measurements of the bleaching spectra were performed in the wavelength range 350-800 nm using the following ketones as models: acetone, methyl butyl ketone, and dipropyl ketone. The spectra of selective bleaching obtained for all types of aliphatic ketones were similar. Based on these spectra the two kinds of chemical traps of electrons in ketones were interpreted as molecular anions and anion radicals. Recombination of charges is not the only mechanism leading to the formation of radiothermoluminescence (RTL) centers. For higher aliphatic ketones, recombination within the charge transfer complexes is likely to be an additional source of RTL emission. The contribution of this type of RTL is inversely proportional to ketone polarity. (auth)

**11554** ELECTRON REACTIONS AND ELECTRON TRANSFER REACTIONS CATALYZED BY MICELLAR SYSTEMS. Graetzel, M.; Kozak, J. J.; Thomas, J. K. (Univ. of Notre Dame, IN). J. Chem. Phys.; 62; No. 5, 1632-1640(1 Mar 1975).

The kinetics of the reaction of hydrated electrons with pyrene, pyrene butyric acid, and pyrene sulfonic acid (PSA) have been investigated in aqueous solutions of cetyltrimethylammonium bromide (CTAB). With all three solubilizates the formation of the electron adduct ($P^-$) occurs very rapidly with rate constants greater than $10^{11}$ $M^{-1} \cdot sec^{-1}$. These abnormally high rate constants are shown to be due to fast trapping of $e^-$/sub aq/ in the positive potential field of the middle and subsequent efficient penetration of electrons into the micellar interior. A similar enhancement was observed for electron transfer reactions between $CO_2^-$ and solutes solubilized in or on the micelle. For example $CO_2^-$ readily transfers an electron to pyrene sulfonic acid on the surface of the micelle. This reaction does not occur in homogeneous solution but is catalyzed by the positive electrostatic surface potential. Addition of electrolyte drastically reduces the rate of $e^-$/sub aq/ and

$CO_2^-$ with solubilizates. The Debye-Hueckel theory of electrolytes was invoked to elucidate the role of the charged micellar interface in facilitating the penetration of the electron into the micelle and promoting the electron transfer reaction on the surface. Ion distributions were calculated via solution of a Poisson–Boltzmann equation, generalized to take into account the probable change of the microscopic dielectric constant in the vicinity of the micellar interface. (auth)

# Radiochemistry and Nuclear Chemistry

*Refer also to abstract 11417.*

## Hot-Atom Chemistry

**11555** (CRN-CNPA-74-13) CHEMICAL EFFECTS ASSOCIATED WITH THE (n,γ) REACTION ON PLATINUM ACETYLACETONATE. Belgrave, E. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires). 1974. 74p. (In French). Dep. NTIS (US Sales Only) $5.50.

Thesis. Submitted to Strasbourg Univ., France.

The chemical effects of neutron capture by Pt isotopes in platinum acetylacetonate were studied and compared with the effects obtained in other studies on chelates of lighter elements. The primary chemical effects result from a low value of the recoil energy and the strong probability of internal conversion. The isotopic effect in the retention of $^{199}Pt$, $^{197}Pt$, $^{191}Pt$, $^{197m}Pt$, $^{195m}Pt$, and $^{193m}Pt$ in the solid acetonate was determined and correlated with the number of photons emitted in cascade. It was shown that internal conversion also plays an important role in the isotopic effects. The nature and origin of the decomposition products observed during irradiation were determined. (JSR)

**11556** EFFECT OF PRESSURE ON THE HOT REACTIONS OF TRITIUM WITH BUTANE. N'Guyen Cong, H.; Paulus, J. M. (Louis Pasteur Univ., Strasbourg. Radiochem. Radioanal. Lett.; 23: No. 2, 85-92(20 Oct 1975). (In French)

In neutron irradiated mixtures of butane, $^3He$ and $I_2$ or $Br_2$ in the pressure range from 100 to 1500 torrs, the yield of tritiated alkanes increases with the pressure, while the yields of $C_2H_3T$ and tritiated radicals decrease with increasing pressure. The primary substitution product $C_4H_9T$ has a broad excitation energy spectrum. At least 80% of the events occur without any fragmentation; while at the uttermost in 1.5% of the cases a carbon-hydrogen bond is broken. (auth)

**11557** ANOMALY OF EUROPIUM POUND IN HOT ATOM CHEMICAL STUDIES OF SOLID LANTHANOIDE DIPIVALOYLMETHANATE COMPLEXES. Amano, R.; Nio, H.; Sakanoue, M. (Univ., Kanazawa, Japan). Radiochem. Radioanal. Lett.; 23: No. 2, 63-69(20 Oct 1975).

In hot atom chemical studies of solid lanthanoide dipivaloylmethanate, it was found by applying the vacuum sublimation method that europium had an anomalous retention value as compared with those of other lanthanoide elements. Retention values were 80% on an average for La, Pr, Gd, Yb, and Sc. However, for Eu, the retention value was 60%. The behavior of europium may be explained by its special tendency to form the +2 valency state. (auth)

**11558** COMBINATION OF THE GAS JET RECOIL TECHNIQUE WITH THE FAST CHEMICAL ON-LINE SEPARATION SYSTEM SISAK. Trautmann, N. (Univ., Mainz); Kaffrell, N.; Stender, E.; Aronsson, P. O.; Bjoernstad, T.; Kvale, E.; Skarestad, M.; Skarnemark, G. Inorg. Nucl. Chem. Lett.; 11: No. • 11, 729-735(Nov 1975).

The fast chemical on-line separation system SISAK has been connected to a gas jet recoil transport arrangement. Pure fractions of short-lived La, Ce and Pr nuclides have been isolated from complex mixtures of reaction products obtained by thermal-neutron-induced fission of $^{235}U$. (auth)

## Properties of Radioactive Materials

*Refer also to abstracts 11524, 11777, 11779–11783, 12013, 12677, 12688, 12693, 14079, and 14081.*

**11559** (CONF-750827-) PROCEEDINGS OF THE CONFERENCE ON DECONTAMINATION AND DECOMMISSIONING (D AND D) OF ERDA FACILITIES, IDAHO FALLS, IDAHO, AUGUST 19–21, 1975. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Sep 1975. 521p. Dep. NTIS $13.75.

Twenty-nine items have been abstracted separately for Nuclear Science Abstracts and ERDA Energy Research Abstracts. (LK)

*For abstracts of individual papers see: 11560–11564, 11585, 11591–11593, 11777, 11779–11783, 12013, 12677, 12684–12686, 13919, 14024, 14078–14083, and 14203.*

**11560** (CONF-750827--, pp 7-14) DECONTAMINATION AND DECOMMISSIONING POLICY AND PROGRAMS. Glauberman, H. (Energy Research and Development Administration, Washington, DC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The policies, objectives, and the program structure for the management of surplus radioactively contaminated ERDA facilities are reviewed. (LK)

**11561** (CONF-750827--, pp 47-58) DEVELOPMENT OF DISPOSITION CRITERIA DERIVATION METHODOLOGY FOR COMMERCIAL FUEL CYCLE FACILITIES. Waite, D. A.; Jenkins, C. E. Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

A technique for deriving disposition criteria for the release and use of nuclear facilities has been developed. The criteria (1) are based on a consistent system of rationale, (2) give quantitative guidance on acceptable levels for release of nuclear facilities, (3) are applicable to all of the identified use restriction categories and (4) are adaptable to different types of nuclear facilities. Rationale for the derivation methodology and criteria acceptability standards are discussed. The derivation mechanism is developed and applied to a plutonium fuel fabrication facility. Present and future extension of the technique is indicated. (auth)

**11562** (CONF-750827--, pp 223-232) SUMMARY REVIEW OF MOUND LABORATORY'S EXPERIENCE IN D AND D OF RADIOACTIVE FACILITIES, 1949--1973. Garner, J. M.; Davis, W. P. (Mound Lab., Miamisburg, OH). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The objective of Mound Laboratory's Decontamination and Decommissioning (D and D) projects has been the effective termination of radioactive material processing facilities with no significant personnel exposures or environmental releases. This objective must be met with available resources and manpower. Mound has effectively decontaminated and/or decommissioned four major facilities in the 1949 through 1973 time period. Many minor areas were also decontaminated and/or decommissioned during this period. The major D and D projects involved the following isotopes: polonium-210, radium-226, actinium-227, and plutonium-238. To achieve a D and D status, Mound has employed several control and decontamination techniques such as: "Navy Cocooning", entombment, removal, foaming, bagging, tents, chutes, portable exhausters, dry ice, vents, bubble suits, three-zones, fire watches, painting and sealing, in-line cleaning, high pressure water blaster, and chemical cleaning. (auth)

**11563** (CONF-750827--, pp 233-252) DECOMMISSIONING OF THE FISSION PRODUCT DEVELOPMENT LABORATORY AT HOLIFIELD NATIONAL LABORATORY. Schaich, R. W. (Holifield National Lab., Oak Ridge, TN). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The decontamination of the Fission Product Development Laboratory was initiated in FY 1975 after 17 years of processing fission product waste streams to produce commercial quantities of $^{90}Sr$, $^{137}Cs$, $^{144}Ce$, and $^{147}Pm$. The objective of the decommissioning program is the removal of all radiation and contamination areas in the facility to a level which will be compatible with the environment in the foreseeable future. (auth)

**11564** (CONF-750827--, pp 295-302) DISMANTLING AN ALPHA-CONTAMINATED FACILITY. Caldwell, R. D.; Harper, R. M. (E. I. du Pont Co., Aiken, SC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The difficult task of removing large pieces of highly contaminated equipment from an obsolete plutonium-239 facility was completed in a seven-month operation that included structural alteration of the process building. Detailed job planning, job execution and contamination control were major factors in accomplishing the task. (auth)

**11565** (INR-P-1462/5/C/C) ENTHALPY OF SOLUTION AND COMPLEXATION OF SOME SERIES LANTHANIDE COMPOUNDS. Fidelis, I. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 9p. (In Polish). INIS.

Discussion of the enthalpy and entropy effect on the complexation of lanthanides has been made on the basis of review of thermodynamic functions for the most popular lanthanide compounds. The contribution of the entropy to the complexation of lanthanides has been underlined. The plots of $\Delta H^{\circ}$ vs Z, obtained by Staveley as a result of elimination of the hydration part of both simple and complex ions—upon the enthalpy of solution of isomorphous salts have have been presented. The pattern of the double–double effect has been shown as existing in those plots. (auth)

**11566** (JINR-R-12-7758) CHEMICAL EFFECTS CONNECTED WITH VARIOUS PROCESSES OF RADIOACTIVE DECAY OF Ce ISOTOPES IN COMPLEXES WITH POLYAMINO-POLYCARBOXYLIC CHELATING LIGANDS. Bajer, G. Yu.; Kherrmann, Eh.; Khalkin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 26p. (In Russian). INIS.

20 refs.

Electron capture and internal conversion lead to practically 100% conversion of daughter atoms to the ion form in the decay of cerium isotopes in a compound of polyamino-polycarboxyl complexes. Destruction of the initial molecule does not depend on the nature of the ligand. The accompanying beta decay effect of electron coincidence releases 19% of the daughter atoms. This process also does not depend on the nature of the ligand. Daughter atoms in +4 states by an internal complex oxidation-reduction process are reduced to a +3 state and remain bound with the ligands formed as a result of the oxidation. These ions may be transformed to the free form by exchange reactions in the solution. (tr-auth)

**11567** (KURRI-TR-122, pp 60-64) CHEMICAL PROPERTIES OF SUPERHEAVY ELEMENTS. Fujiwara, I. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

Some examples of prediction for the chemical properties of superheavy elements are reviewed, and their predicted properties are summarized. The element that has atomic number 118 is the first element, for which prediction was made on its chemical properties. The orbital computation of electron bonding energy and X-ray energy are described for the elements, number 114, 126 and 140. The methods of calculating electron arrangement are briefly explained. The chemical properties predicted by those methods are listed by classifying into five groups, namely (1) 6d transition elements, atomic number 104 to 112, (2) 7p and 8s elements, atomic number 113 to 120, (3) 6f and 5g elements, atomic number 121 to 154, (4) elements, atomic number 156 to 172 and 184. The computation using relativistic hamiltonian calculation method may be necessary for the estimation of the chemical behavior of superheavy elements. It is impossible to accurately calculate not only chemical properties but also atom and ion many body problem at present. But the most stable electron arrangement of atoms and ions in conjunction with their ionization energy and electron binding energy can be calculated fairly accurately together with their wave function. The computed chemical properties are only a part of whole properties. Thus computed values must be examined in comparison with the trend of known elements. (JA)

**11568** (ORO-4447-031) PHYSICAL–CHEMICAL STUDIES OF TRANSURANIUM ELEMENTS. Progress Report, April 1, 1975–March 31, 1976. Peterson, J. R. (Tennessee Univ., Knoxville (USA). Dept. of Chemistry). 1975. Contract AT(40-1)-4447. 28p. Dep. NTIS $4.00.

Major advances in our continuing program to determine, interpret, and correlate the basic chemical and physical properties of the transuranium elements are summarized for the period April 1, 1975, to March 31, 1976. Several instrumentation improvements were made which significantly improve the performance and data handling capabilities of our microscope-spectrophotometer. Spectroscopic and complementary x-ray powder diffraction studies were carried out on $EsBr_3$, $EsCl_3$, EsOBr, an Es(III) bromide, an Es(III) iodide, $CfI_3$, and $CfI_2$. As yet $EsBr_3$ has not been shown to undergo thermal reduction in a manner analogous to $CfBr_3$. Single crystals of $K_4NpO_2(CO_3)_3$, $BaNpO_2(C_2H_3O_2)_3 \cdot 2H_2O$, $Na_4NpO_2(O_2)_3 \cdot 9H_2O$, and $Na_4UO_2(O_2)_3 \cdot 9H_2O$ were grown and analyzed by x-ray diffraction and absorption spectroscopy. Precise bond distances were determined, and the spectral behavior of the neptunyl ion was observed as a function of crystal orientation and ligand field. The performance of our solution microcalorimeter was improved by rebuilding the wheatstone bridge, installing a high-quality ground, and developing further a sample containment bulb which will minimize the possibility of incomplete dissolution of the sample. A micropolarographic cell was developed, evaluated, and used in several attempts to determine the Es(III)–Es(II) potential in acetonitrile. Experimental difficulties were encountered in the handling and dissolution of the einsteinium. (auth)

**11569** (STI/PUB-398) INTERNATIONAL DIRECTORY OF CERTIFIED RADIOACTIVE MATERIALS. (International Atomic Energy Agency, Vienna (Austria)). 1975. 106p. UNIPUB, Inc., New York $6.00

The products of 13 suppliers of certified reference materials of radioactivity as given in their catalogs are listed. The products are divided into five groups: solutions and reagents, gaseous sources, solid sources, neutron sources, and miscellaneous. (LK)

**11570** DETERMINATION OF THE VAPOR PRESSURE OF URANIUM TETRACHLORIDE BY THE GAS SATURATION METHOD. Association of Uranium Tetrachloride in Gas Phase. Sawlewicz, K.; Siekierski, S. (Inst. of Nuclear Research, Warsaw). Radiochem. Radioanal. Lett.; 23: No. 2, 71-77(20 Oct 1975).

From 7th radiochemical conference; Marianske Lazne, Czechoslovakia (April 1973).

Vapor pressure of uranium tetrachloride has been determined in the temperature range of 748-925°K using the gas saturation method and assuming that uranium tetrachloride is monomeric in the gas phase. The values of vapor pressure so obtained were found to be higher than those obtained from all other methods. This has been explained by assuming that below 900°K a slow process of the association of $UCl_4$ molecules takes place. (auth)

**11571** INITIAL SYNTHESIS OF OLIGOMERIC URANYL POLYESTERS. Carraher, C. E. Jr.; Schroeder, J. A. (Univ. of South Dakota, Vermillion). J. Polym. Sci., Polym. Lett. Ed.; 13: No. 4, 215-219(Apr 1975).

The initial synthesis of uranyl polyesters from the reaction of $UO_2^{+2}$-containing moieties with acid salts is reported. (LK)

**11572** CHEMISTRY OF URANIUM. XII. Nitrate Complexes of Uranium(IV) and Thorium(IV). Du Preez, J. G. H.; Van Vuuren, C. P. J. (Port Elizabeth Univ., South Africa). J. Chem. Soc. (London), Dalton Trans.; No. 15, 1548-1552(1975).

The behavior of $[NO_3]^-$ as anionic ligand towards Th(IV) and U(IV) in the presence of various amounts of trimethylphosphine and tris(dimethylamino)phosphine oxides has been studied in nonaqueous media by conductometric, spectroscopic, and enthalpimetric methods. The relation between species present in solution and solids isolated and the influence of cation- and neutral-donor ligand size on the action of nitrate as a donor have been investigated. (auth)

**11573** REDUCTION OF PERTECHNETATE-99 BY STANNOUS CHLORIDE. I. The Stoichiometry of the Reaction in HCl, in a Citrate Buffer and in a DTPA Buffer. Steigman, J. (Brookhaven National Lab., Upton, NY); Meinken, G.; Richards, P. Int. J. Appl. Radiat. Isot.; 26: No. 10, 601-609(Oct 1975).

The reduction of pertechnetate-99 by excess stannous chloride in several media was investigated as a possible model for radiopharmaceutical preparations which are based on the reduction of pertechnetate-99m by the same reagent. Polarographic and iodimetric techniques were used to analyze for unreacted stannous ion. It was found that pertechnetate is reduced to the +4 state in a citrate buffer at pH 7, to the +3 state in a DTPA buffer at Ph 4, and possibly to the +4 state in HCl. The reaction in DTPA solution was found to be complete within several minutes. The reduction in the citrate buffer proceeded rapidly to the +5 state, and much more slowly to the +4 state. The implications of these rate studies for the radiopharmaceutical preparations were discussed. Direct potentiometric titrations of pertechnetate-99 with stannous chloride showed that the technetium was in the +4 state in HCl, in the +5 state in citrate solution, and in both the +3 and +4 states in DTPA. (auth)

**11574** SYNTHESIS OF [4-$^{14}$C]-3$\alpha$, 20 $\alpha$-DIAMINOPREGN-5-ENE OR [4-$^{14}$C] 3-EPI-IREHDIAMINE A. Hoellinger, H.; Nam, N. H. (Institut National de la Sante et de la Recherche Medicale (INSERM), Hopital Fernand Widal, 75-Paris (France)); Pichat, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service des Molecules Marquees). Bull. Soc. Chim. Fr.; No. 1, 237-240(Jan 1975). (In French).

[4-$^{14}$C]-3-epi-irehdiamine A (specific activity = 19 mCi/mM) is stereospecifically prepared from either [4-$^{14}$C]-pregnenolone or [4-$^{14}$C]-3$\beta$-trimethylsilyloxy-pregna-3,5-diene-20-one. (FR)

**11575** METHYLVINYLSULPHONE DERIVATIVES. Synthesis of [$^{14}$C]-Labelled Methyl 2,2-Diphenylvinylsulphone. Fillion, H.; Luu Duc, C. (Grenoble-1 Univ., 38-La Tronche (France)); Agnius-Delord, C. (Grenoble-1 Univ., 38 (France). Inst. des Isotopes Radioactifs). Bull. Soc. Chim. Fr.; No. 12, 2923-2924 (Dec 1974). (In French).

[$^{14}$C]-labelled methyl 2,2-diphenylvinylsulfone has been synthesized in order to study its metabolism. The various methods for its preparation are discussed. The action of the methyl-sulphenyl carbanion on [$^{14}$C]-benzophenone, prepared by Grignard synthesis, affords methyl-2-hydroxy-2,2-diphenylethyl sulphoxide, which is oxidized to sulfone by hydrogen peroxide. Dehydration of the sulfone, using phosphoric acid, leads to the required [$^{14}$C]-labelled vinylsulphone. (FR)

**11576** NEW METHOD FOR CONVERTING [4-$^{14}$C]-PROGESTERONE INTO [4-$^{14}$C]-PREGNENOLONE VIA THE [4-$^{14}$C]-3$\beta$-TRIMETHYLSILYLOXY-20,20-ETHYLENEDIOXY-PREGNA-3,5-DIENE. Hoellinger, H.; Nguyen Hoang Nam (Institut National de la Sante et de la Recherche Medicale (INSERM), Hopital Fernand Widal, 75-Paris (France)); Pichat, L. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service des Molecules Marquees). Bull. Soc. Chim. Fr.; No. 1, 233-236(Jan 1975). (In French).

[4-$^{14}$C]-progesterone is converted into [4-$^{14}$C]-20,20-ethylenedioxypregn-4-ene-3-one through the eniminium perchlorate intermediate. Silylation of the ethylenedioxy derivative gives rise to [4-$^{14}$C]-3$\beta$-trimethylsilyloxy-20,20-ethylenedioxypregna-3,5-diene which is reduced stereospecifically into [4-$^{14}$C]-3$\beta$-hydroxy-20,20-ethylenedioxy-5-pregnene. Cleavage of the protecting group leads to [4-$^{14}$C]-pregnenolone with a radiochemical yield of 50% based on [4-$^{14}$C]-progesterone after purification; specific activity: 59mCi/mM. (FR)

**11577** APPARATUS FOR THE SEPARATION OF SOLID PARTICLES FROM A LIQUID. (to UKAEA; British Nuclear Fuels Ltd.). French Patent 2,224,191/A/. 8 Apr 1974. 10p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France); priority claim: 9 Apr 1974, UK.

**11578** RADIOISOTOPE GENERATORS IN PREPARATION OF RADIOPHARMACEUTICALS. Blaha, V. (Centralni Izotopove Pracoviste Institutu Klinicke a Experimentalni Mediciny, Prague (Czechoslovakia)); Krivsky, Z. (Subkatedra Nuklearni Mediciny Institutu pro Dalsi Vzdelavani Lekaru a Farmaceutu, Prague (Czechoslovakia)). Cesk. Farm.; 22: No. 4, 176-179(May 1973). (In Czech).

The decay scheme is described of $^{99m}$Tc and $^{113m}$In, currently the most common radioisotope generator products. Listed are the physical half-lives of the respective decay products, the type of decay, and the energy of gamma or beta radiation. A survey is given of diagnostic techniques using $^{99m}$Tc and $^{113m}$In. It is shown that the absorbed dose resulting from the application of generator radiopharmaceuticals is much lower than that resulting from the use of radiopharmaceuticals labelled with the so-called classical, non-generator radioisotopes, such as $^{131}$I, $^{198}$Au, $^{203}$Hg, $^{197}$Hg, and others. (INIS)

**11579** CONDITIONS AND CHARACTERISTICS OF THE PREPARATION OF RADIOPHARMACEUTICALS AT NUCLEAR MEDICINE WARDS. Charamza, O. (Fakultni Nemocnice, Olomouc (Czechoslovakia). Oddeleni Nuklearni Mediciny). Cesk. Farm.; 22: No. 4, 180-182(May 1973). (In Czech).

Excerpts from a paper submitted to the 21st pharmacological symposium, Plzen, Czechoslovakia, 6 Sep 1971.

The preparation of radiopharmaceuticals in nuclear medicine wards is discussed and the characteristic features are considered affecting the preparation, such as the presence of the radioisotope and the different conditions of hospital and of pharmacy laboratories. Requirements are stressed, such as sterility and radiochemical purity of the resulting product and its stability. (INIS)

**11580** RADIOPHARMACEUTICALS. Grossmann, V. (Farmakologicky Ustav Lekarske Fakulty KU, Hradec Kralove (Czechoslovakia)). Cesk. Farm.; 22: No. 4, 173-175(May 1973). (In Czech).

A brief review is presented giving the classification of radiopharmaceuticals as to their chemical form and to their administration. The application of radiotherapeutical and of radiodiagnostical drugs is described. (INIS)

**11581** ELECTRICAL CONDUCTIVITY OF URANIUM AND THORIUM DIPHTHALOCYANINES. Preobrazhenskii, N. I.; Kolyadin, A. B. Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 3, 402-404(Mar 1975).

Translated from Zh. Fiz. Khim.; 49: No. 3, 692-694(Mar 1975).

The temperature dependence of the dark conductivity of uranium and thorium diphthalocyanines was studied. The effect of heat treatment in oxygen and in vacuum on the conductivity and on the thermal activation energy of $UPc_2$ and $ThPc_2$ is discussed. (auth)

**11582** RADIOPHARMACEUTICALS PREPARED WITH STANNOUS CHLORIDE. Alvarez, J. (National Inst. of Nuclear Energy, Mexico City). J. Radioanal. Chem.; 27: No. 2, 475-482(1975).

The preparation of radiopharmaceuticals using stannous chloride has acquired an ever increasing importance. The applicability to a great number of compounds constitutes the basis of interest. The possibility of preparing kits has added to the desirable properties. The stannous ion is a powerful reducing agent, it possesses the quality of coprecipitating with numerous elements and favors the formation of many complexes of relatively low toxicity. The present outline is a panoramic appreciation of the radiopharmaceuticals prepared with the aid of stannous chloride, some brief considerations on quality control have found their way into this exposition. (auth)

**11583** SINGLE-CRYSTAL GROWTH OF $MF_2$: $UF_4$: $CeF_3$ (M equals Ca, Sr, Ba) SOLID SOLUTIONS. Catalano, E.; Wrenn, E. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). J. Cryst. Growth; 30: No. 1, 54-60(Aug 1975).

The melt growth of solid-solution single crystals of $MF_2$:$UF_4$: $CeF_3$(M equals Ca, Sr, Ba) is described. Comments on relevant parts of binary $MF_2$-$UF_4$ systems applicable to the crystal-growth problem and some new information are also presented. The question of a crystallographic phase transformation in pure $UF_4$ was investigated. (NL)

## *Radioactive Waste Treatment*

**11584** (BNWL-1945) PYROLYSIS: INCINERATION OF SIMULATED COMBUSTIBLE ALPHA WASTES. Mudge, L. K.; Schiefelbein, G. F.; Sullivan, R. G.; Walter, R. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract E(45-1)-1830. 49p. Dep. NTIS $5.45.

Design, fabrication, and installation of a unit to demonstrate pyrolysis-incineration of simulated alpha wastes are described. The main reactor in the unit is a cylinder 7 ft long, lined with refractory in the lower 5$\frac{1}{2}$ ft to give an effective inside diameter of about 11 in. Four experimental runs, using simulated alpha wastes, were completed. Average processing rates of 27 lb/hr were achieved. The waste components were shredded to an average size of 4 in. The ash content of the simulated waste was 3.6 wt percent. The composition of the off-gas from the process was determined using a gas chromatograph. Condensates (or tars) were collected during a 12-hr run and totaled 18 percent of the weight of the simulated feed that was processed. These tars had a calorific heating value of 9380 cal/g and a viscosity of 750 cp at 50 $^0$C. Ash content of these tars was 0.3 wt percent. Ash collected during a 12-hr run appeared dark gray in color and had a bulk tap density of 0.76 g/cm$^3$. The ash was found to contain 13 wt percent unburned carbon. This unburned material represents 0.5 wt percent of the waste treated in the process. For this particular waste composition and ash content, the volume reduction factor was 140. (auth)

**11585** (CONF-750827--, pp 275-294) PROCESSING EBR-I NaK TO PRODUCE A STORABLE SOLID. Hammer, R. R.; Lewis, L. C. (Allied Chemical Corp., Idaho Falls, ID). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

Approximately 5500 gallons of fission product—contaminated liquid metal coolant (eutectic sodium–potassium alloy—NaK), was removed from the EBR-I reactor system, reacted with caustic solution to produce a solid 25 M potassium hydroxide–sodium hydroxide mixture suitable for storage at the Idaho National Engineering Laboratories RWMC. Considerations that went into

the design and operation of the processing unit will be discussed. (auth)

**11586** (GA-A-13708) WASTE MANAGEMENT CONSIDERATIONS IN HTGR RECYCLE OPERATIONS. Pence, D. T.; Shefcik, J. J.; Heath, C. A. (General Atomic Co., San Diego, Calif. (USA)). 7 Nov 1975. Contract E(04-3)-167. 17p. (CONF-751101-59). Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Waste management considerations in the recycle of HTGR fuel are different from those encountered in the recycle of LWR fuel. The types of waste associated with HTGR recycle operations are discussed, and treatment methods for some of the wastes are described. (LK)

**11587** (ORNL-TM-5064) FIXATION OF RADIOIODINE WITH PORTLAND CEMENT. I. Preliminary Scoping Studies. Clark, W. E.; Thompson, C. T.; Howerton, W. B. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 53p. AT.

Data are presented for the short-term (≤ 7 months) leaching of iodine from concrete specimens containing 2.9, 5.7, 7.5, and 9.05 wt % iodine as barium iodate. In this study, which is still in progress, the incremental leach rates of specimens leached for 205 days have decreased to less than $10^{-4}$ cm/day. Those containing 9.05 wt % iodine have been leached for much shorter periods, and only the best specimens (i.e., those containing either butyl stearate or fluosilicic acid as additives) show leach rates as low as $10^{-4}$ cm/day. Fixation of radioiodine as barium iodate in concrete offers possibilities for actual disposal. The product, if prepared free of all radionuclides except iodine, is a low-level waste and can be transported and stored like other solid low-level wastes. The total daily iodine output of a 5-metric ton/day LMFBR fuel reprocessing plant can be contained in only 0.335 $ft^3$ of concrete. Heat generation in a product containing 9.05 wt % iodine would amount to only $3.3 \times 10^{-3}$ W per metric ton of concrete. Recommendations are made for further work toward optimizing the product. (auth)

## Radioisotope Production

*Refer also to abstract 12562.*

**11588** (INIS-mf-1750) DEVELOPMENT OF A ROUTINE SCALE PRODUCTION OF IODINE 131. Elizalde, V. F. L. (Universidad Nacional Autonoma de Mexico City. Facultad de Quimica). 1973. 54p. (In Spanish). INIS.

Three methods were developed experimentally for the separation of $^{131}I$ from Te irradiated by a neutron flux. These methods are distillation in acid medium, distillation in base medium, and dry distillation. In order to select an adequate separation method for the production of $^{131}I$, the experimental results of the percentage of $^{131}I$ in the residues and the percentage lost were subjected to statistical tests which showed that the three method was statistically equal. The dry distillation method was selected and experimental equipment was proposed to study the optimum operating conditions for the separation of $^{131}I$ from irradiated Te. (tr-INIS)

**11589** STERILE, MULTICOMPONENT $^{81}Rb$-$^{81m}Kr$ MINIGENERATOR AND DELIVERY SYSTEM. Mayron, L. W.; Friedman, A. N.; Kaplan, E.; Gindler, J. E. (Veterans Administration Hospital, Hines, IL). Int. J. Nucl. Med. Biol.; 2: No. 3, 141-142 (Jul 1975).

Modifications and improvements in the design and construction of a $^{81}Rb$-$^{81m}Kr$ minigenerator and delivery system are described in detail. Sterility is ensured by the use of a Swinny filter (with a 0·45 μm membrane), and the delivery system can incorporate either a 3-way stopcock or a Y-tube to allow for the direct introduction of pharmaceuticals effecting vascular or perfusion changes. The Teflon catheters used will feed into and through standard cardiac catheters, and $^{81m}Kr$ can be infused whenever such a standard catheter may be placed. The small diameter of the Teflon minibore catheter makes direct insertion into the coronary arteries and their branches possible. The myocardial perfusion of each subartery can therefore be studied. (UK)

## Reactor Fuel Reprocessing

*Refer also to abstract 12678.*

**11590** (BARC-790) IN-LINE ANALYTICAL METHODS FOR FUEL REPROCESSING STREAMS. Part IV. Neutron Monitoring for Plutonium. Rao, V. K.; Bhargava, V. K.; Marathe, S. G.; Iyer, R. H.; Ramaniah, M. V.; Srinivasan, N. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). 1975. 25p. Dep. NTIS (US Sales Only) $4.75.

A neutron monitoring assembly consisting of a stainless steel housing packed with beryllium oxide chips, a paraffin moderator, a ring of fifteen $BF_3$ counters and an all stainless steel continuous flow system for circulating plutonium solutions has been fabricated and tested for monitoring plutonium concentrations in flowing solutions. The method is based on the detection and measurement of neutron flux produced when alpha particles from plutonium interact with beryllium by the nuclear reaction $^{9}_{4}Be(\alpha,n)^{12}_{6}C$. The unit was successfully tested for the estimation of plutonium concentrations up to about 10 g/l. Several unknown solutions of plutonium and plutonium solutions mixed with uranium and fission products were analyzed using the present set-up and it was demonstrated that these solutions can be monitored continuously, with an accuracy of 10-15%. Details of the construction and working of the system are discussed. (auth)

**11591** (CONF-750827--, pp 23-28) STATUS OF ANSI STANDARDS ON DECOMMISSIONING OF NUCLEAR REPROCESSING FACILITIES. Graham, H. B. (Holifield National Lab., Oak Ridge, TN). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

A definition of decommissioning is given, and the preparation of ANSI Standard, "General Design Criteria for Nuclear Reprocessing Facilities" (N101.3) is discussed. A Eurochemic report, entitled "The Shutdown of Reprocessing Facilities–Results of Preliminary Studies on the Installations Belonging to Eurochemic," was used in the preparation of this standard. (LK)

**11592** (CONF-750827--, pp 59-70) DECONTAMINATION AND DECOMMISSIONING OF LICENSED FUEL REPROCESSING PLANTS. Chitwood, R. B. (Nuclear Regulatory Commission, Washington, DC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

Design criteria for decommissioning nuclear fuel reprocessing plants, decontamination experience, decommissioning alternatives, and disposal of radioactive wastes are considered. (LK)

**11593** (CONF-750827--, pp 153-164) DECONTAMINATION OF A HIGHLY RADIOACTIVE CHEMICAL PROCESSING FACILITY. Moore, P. R. (E. I. du Pont de Nemours and Co., Aiken, SC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

Five modules of the highly radioactively contaminated "hot canyon" in one of the chemical processing plants for irradiated fuel at Savannah River Plant were successfully decontaminated for installation of a new process. Decontamination was completed in about one year at a cost of about $150,000. The various techniques employed, equipment used, and the overall job plan are described. (auth)

**11594** (ICP-1074) INTERIM RESULTS: DEVELOPMENT OF A HEAD-END PROCESS FOR RECOVERING URANIUM AND THORIUM FROM CRUSHED FORT ST. VRAIN FUEL. Hogg, G. W.; Rindfleisch, J. A.; Palmer, W. B.; Anderson, D. L.; Vavruska, J. S. (Allied Chemical Corp., Idaho Falls, Idaho (USA). Idaho Chemical Programs—Operations Office). Oct 1975. Contract E(10-1)-1375. 107p. Dep. NTIS $5.45.

Development of processes and equipment for recovering uranium and thorium from crushed Ft. St. Vrain fuel is described. Primary burning, particle classification, particle breaking, secondary burning, and aqueous processing were studied. Interim pilot-plant results show that: (1) graphite can be burned at the plant equivalent rate of 35 kgC/hr-$ft^2$ in the primary burner and that fines can be consumed by recycle to the primary burner; (2) separation to greater than 95 percent pure fissile and 85 percent pure fertile particles can be effected by a gas classifier; (3) gas jets are capable of breaking silicon carbide coatings at rates compatible with plant requirements; gas utilization efficiencies are sufficiently great that off-gas generated by the jets is less than 5 percent of

the off-gas generated by the process equipment; (4) an artificial inert bed is not required for secondary burning and the carbon content of the bed can easily be reduced to less than 2 percent in the secondary burner; (5) corrosion rates of thorex solution on 304 L stainless steel are sufficiently low to allow the dissolver to be constructed of 304 L stainless steel; and, (6) solids–liquid separation efficiencies using a continuous solid-bowl centrifuge are sufficiently high to process the dissolver product in a pulse-column extractor. Basic data on the process materials and conditions germane to the safety analysis for the process are also given. (JGB)

**11595** (ORNL-TM-4747) OVERVIEW OF HTGR FUEL RECYCLE. Notz, K. J. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 56p. Dep. NTIS $5.50.

An overview of HTGR fuel recycle is presented, with emphasis placed on reprocessing and fuel kernel refabrication. Overall recycle operations include (1) shipment and storage, (2) reprocessing, (3) refabrication, (4) waste handling, and (5) accountability and safeguards. (auth)

**11596** (ORNL-TM-4947) EMPIRICAL MODEL FOR CALCULATING VAPOR-LIQUID EQUILIBRIUM AND ASSOCIATED PHASE ENTHALPY FOR THE $CO_2$–$O_2$–Kr–Xe SYSTEM FOR APPLICATION TO THE KALC PROCESS. Glass, R. W.; Gilliam, T. M.; Fowler, V. L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 181p. Dep. NTIS $8.50.

An empirical model is presented for vapor-liquid equilibria and enthalpy for the $CO_2$-$O_2$ system. In the model, krypton and xenon in very low concentrations are combined with the $CO_2$-$O_2$ system, thereby representing the total system of primary interest in the High-Temperature Gas-Cooled Reactor program for removing krypton from off-gas generated during the reprocessing of spent fuel. Selected properties of the individual and combined components being considered are presented in the form of tables and empirical equations. (auth)

**11597** (ORNL-TM-5059) CHARACTERIZATION OF EFFLUENTS FROM A HIGH-TEMPERATURE GAS-COOLED REACTOR FUEL REFABRICATION PLANT. Judd, M. S.; Bradley, R. A.; Olsen, A. R. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 50p. Dep. NTIS $5.50.

The types and quantities of chemical and radioactive effluents that would be released from a reference fuel refabrication facility for the High-Temperature Gas-Cooled Reactor (HTGR) have been determined. This information will be used to predict the impact of such a facility on the environment, to identify areas where additional development work needs to be done to further identify and quantify effluent streams, and to limit effluent release to the environment. (auth)

**11598** (ORNL-TM-5096) CHARACTERISTICS OF RADIOACTIVE WASTE STREAMS GENERATED IN HTGR FUEL REPROCESSING. Lin, K. H. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 38p. Dep. NTIS $5.00.

Results are presented of a study concerned with identification and characterization of radioactive waste streams from an HTGR fuel reprocessing plant. Approximate quantities of individual waste streams as well as pertinent characteristics of selected streams have been estimated. Most of the waste streams are unique to HTGR fuel reprocessing. However, waste streams from the solvent extraction system and from the plant facilities do not differ greatly from the corresponding LWR fuel reprocessing wastes. (auth)

**11599** CHEMICAL ANALYSIS AS PRODUCTION GUIDE. Bouzigues, H. (CEA Centre de Pierrelatte, 26 (France). Service Laboratoires); Fontaine, A. (CEA Centre de Marcoule, 30–Bagnols-sur-Ceze (France). Service Laboratoires); Patigny, P. (CEA Centre de La Hague, 50–Cherbourg (France). Section Laboratoires). Bull. Inf. Sci. Tech. (Paris); No. 200, 9-22 (Feb 1975). (In French).

All piloting data of chemical processing plants are based on the results of analysis. The first part of this article describes a system of analyzers adapted to the needs of the Pierrelatte plant, with management of signals collected by the factory computer. Part two shows the influence of analytical development in the establishment of material balance sheets for the Marcoule spent fuel processing plant. Part three stresses the contribution of the automation of analytical test processes at the La Hague spent fuel processing plant. In all three cases the progress in analytical methods greatly improves the safety, reliability, and response time of the various operations. (FR)

**11600** COMBINED EXTRACTION-FLUORIDE REGENERATION OF SPENT FUEL. The Aqua-Fluor Process. Peka, I. Jad. Energ.; 20: No. 11, 390-394(Nov 1974). (In Czech).

The concept and the technology are described of a combined extraction-fluoride process of the reprocessing of spent light-water fuel. The flowchart is given of the Aqua-fluor technology applied in the Midwest Reprocessing Plant in Morris (Illinois, USA). (INIS)

# CONTROLLED THERMONUCLEAR RESEARCH

**11601** PROGRESS IN ASSESSING THE TECHNOLOGICAL PROBLEMS OF FUSION REACTORS. Prevot, F. (CEA Centre d'Etudes Nucleaire de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). pp 291-292 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From first European nuclear conference; Paris, France (21 Apr 1975).

The best results obtained in the world with Tokamak devices are presented and the problems still to be solved are underlined. (FR)

**11602** PLASMA PHYSICS INDEX. Volume 10, No. 7, 1975. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 97p.

**11603** PLASMA PHYSICS INDEX. Volume 10, No. 9, 1975. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 121p.

**11604** PLASMA PHYSICS INDEX. Volume 10, No. 10, 1975. Bibliography, Author Index, Subject Index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 118p.

**11605** TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 9, No. 9, 1975. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 53p.

**11606** TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 9, No. 10, 1975. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 54p.

## Plasma Confinement and Heating

*Refer also to abstract 11753.*

**11607** (CONF-740642-) PROCEEDINGS OF THE SECOND TOPICAL CONFERENCE ON RF PLASMA HEATING, LUBBOCK, TEXAS, JUNE 20-22, 1974. (Texas Tech Univ., Lubbock (USA). Plasma Lab.). 1974. 259p. Dep. NTIS $9.00.

Separate abstracts were prepared for 31 papers and appear in NSA. Abstracts for 23 of the papers appear in ERDA Research Abstracts. (MOW)

*For abstracts of individual papers see: 11608–11627, 11648, 11664, 11669, 11670, 11681, 11752–11756, and 12890.*

**11608** (CONF-740642-, pp A5.1-A5.7) PLASMA LOADING AND WAVE GENERATION FOR ICRH IN THE ST TOKAMAK. Adam, J. (Princeton Univ., NJ); Getty, W. D.; Hooke, W. M.; Hosea, J. C.; Sinclair, R. M. 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In Proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Plasma loading and wave generation for two half-turn loops operating at 25 MHz are being investigated on the ST Tokamak at power levels up to 1 MW. The equivalent series resistance R/sub s/ equals P/sub rf//I$^2$/sub rf/, measured as a function of OMEGA equals omega/omega/sub ci/(r equals 0) and plasma density, is found to be in good agreement with the predictions of the cylindrical theory. R/sub s/ values as high as several ohms are obtained at high densities giving wave generation efficiencies well above 90 percent. Loading near OMEGA equals 1 and 2 is apparently independent of power level. Measurements of B/sub zrf/ at 20 locations about the torus reveal the predicted wave generation; m equals 0, +1 slow waves in the vicinity of OMEGA equals 1, m equals -1 fast waves after the expected onset (usually OMEGA greater than or equal to 1), and m equals 0, +1 fast waves for higher OMEGA. Toroidal eigenmodes accompanied by large loading are detected for the fast waves when the damping lengths are long. (auth)

**11609** (CONF-740642-, pp A7.1-A7.6) ION–ION HYBRID RESONANCE HEATING. Toyama, H. (Univ. of Tokyo). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The accessibility condition and the damping length of the ion–ion hybrid wave are calculated numerically in the density region of $10^{10}$ to $10^{17}$ cm$^{-3}$ using the Langevin collision model, with the ion–ion collision frequency, the parallel wave number, and the D-T concentration ratio as the parameters. It is shown that the heating is effective even for very low collision frequencies encountered in thermonuclear plasmas. (auth)

**11610** (CONF-740642-, pp A8.1-A8.7) ION CYCLOTRON RESONANCE PLUGS OF A CUSPED MAGNETIC TRAP. Hiroe, S.; Watari, T.; Sato, T.; Shoji, T.; Takayama, K. (Nagoya Univ., Japan). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Ion loss flux from a line cusp was suppressed to a few percent by using the rf plug whose resonance frequency was somewhat above the ion cyclotron frequency. The loss rate and the resonance frequency as a function of the ion density were obtained experimentally in the range of n/sub i/ equals $10^8$ approximately 2 x $10^{11}$ cm$^{-3}$, and the results were in good agreement with the theory based on the collective behavior of a plasma. The ambipolar potential produced by charge separation and the suppression of electron loss accompanied with it were also observed. The dependence of the loss rate on the ion energy was measured in a mirror configuration. The ion cyclotron resonance plugs have very small effect for heavy impurity-ions with low degree of stripping. The possibility of impurity-free containment thereby conceived was demonstrated experimentally by using a plasma composed of several ion-species. (auth)

**11611** (CONF-740642-, pp B1.1-B1.10) SURVEY OF LOWER HYBRID STUDIES. Oakes, M. E. (Univ. of Texas, Austin). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

A review of lower hybrid resonance work is presented and recent experiments producing significant ion heating are discussed. (auth)

**11612** (CONF-740642-, pp B3.1-B3.9) MEASUREMENT AND ANALYSIS OF RESONANCE CONE STRUCTURE FROM A FINITE-SIZED SOURCE AT THE HYBRID FREQUENCY. Colestock, P. L.; Getty, W. D. (Univ. of Michigan, Ann Arbor). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Experimental and theoretical investigations of wave propagation from a finite-sized source near the lower-hybrid frequency in an inhomogeneous plasma column are described. The wave is excited electrostatically by coaxial half-cylinders. In the present work, measurements of the rf potential show the occurrence of resonance cones along trajectories emanating from the ends of the cylinders as described for the finite source by Bellan and Porkolab. The numerical solution for an oscillating ring charge in a hot plasma has been obtained to determine the effects of T/sub e/ and T/sub i/ on the resonance cone structure. Results show a peak in the rf potential along the resonance cones in agreement with experiment. In addition, the numerical results show a short-wavelength, low-amplitude oscillation occurring on the low-density side of the resonance cone. (auth)

**11613** (CONF-740642-, pp B4.1-B4.6) LOWER-HYBRID HEATING IN LARGE TOKAMAK. Troyon, F.; Perkins, F. W. (Princeton Univ., NJ). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The extension of heating techniques which rely on the excitation of an electrostatic wave in the vicinity of the lower-hybrid resonance frequency or higher to large, dense, and hot tokamaks meets new problems: (1) Linear damping on the electrons, and on the ions if T/sub i/ greater than or equal to T/sub e/, is very strong at temperatures of a few keV and impose a low value of

N/sub parallel/, typically less than 2. (2) Accessibility requires N/sub parallel/ to be of the same order of magnitude leaving at best a narrow window. (3) Coupling structures excite a wide range of N/sub parallel/, only a fraction of which will heat the center. Excitation of the fast wave widens the accessible range but the larger evanescent layer near the coupler may present new problems. (auth)

**11614** (CONF-740642-, pp B5.1-B5.6) HEATING OF HIGHLY IONIZED PLASMA IN THE LOWER HYBRID FREQUENCY RANGE. Takamura, S.; Okuda, T. (Nagoya Univ., Japan). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

In order to examine the accessibility of the high-frequency heating of plasma in the lower hybrid frequency range, the interactions between the high-frequency electromagnetic field and a highly ionized plasma were studied. In the case of the low power the absorption coefficients were measured, while in the case of the high power the changes of the energy density of plasma were examined. These experimental observations are compared with the theory of the linear mode conversion. (auth)

**11615** (CONF-740642-, pp B6.1-B6.6) LOWER HYBRID RESONANCE HEATING IN A HOT ELECTRON PLASMA. Shohet, J. L.; Raimbault, P. A. (Univ. of Wisconsin, Madison). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Electron and ion heating have been observed when rf at a frequency close to the lower hybrid resonance is coupled electrostatically into a hot electron plasma by means of an appropriate structure. The rf heating frequency is 10 MHz at a power of 500 W. The hybrid layer is identified with a rf interferometer correlated with density measurements. The electron temperature profile shows that the heating zone is located on the low density side of the hybrid layer. Plasma is expelled from the heating zone along the magnetic field lines. Relativistic electrons produced by the ECRH source at low pressure tend to limit the amount of electron heating by the rf, and a slight increase in ion temperature occurs as well. The maximum electron heating appeared to occur whenever the product of the perpendicular wave number and the electron gyro radius was approximately unity. (auth)

**11616** (CONF-740642-, pp B7.1-B7.6) NUMERICAL SIMULATION OF LOWER HYBRID RESONANCE HEATING OF A TWO-DIMENSIONAL MAGNETIZED PLASMA. Emery, M. H. (Univ. of Iowa, Iowa City); Joyce, G.; Shohet, J. L. 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The response of a two-dimensional magnetized plasma to excitation by an external field at the lower hybrid frequency is examined by numerical simulation. The ions are magnetized; the electrons are guiding center. It is concluded that (1) the heating is not collisional, (2) heating is greatest for (k/sub perpendicular/rho/sub ci/)$^2$ approximately equal to 1, (3) heating is improved for frequencies slightly above the hybrid frequency, (4) and for omega/sub ci//omega/sub pi/ greater than 1, and (5) the heating is caused by excitation of a normal mode which leads to mode coupling and subsequent trapping of the ions. The results concur with those of Raimbault and Shohet. (auth)

**11617** (CONF-740642-, pp C5.1-C5.6) OVERDENSE RADIO FREQUENCY SOURCE. Bernabei, S.; Hooke, W. M.; Jassby, D. L.; Motley, R. W. (Princeton Univ., NJ). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

One of the more attractive techniques for the supplementary heating of large tokamak devices involves the application of radio frequency power near the lower hybrid frequency (LHF). The fundamental engineering advantages of this approach are twofold: (1) At frequencies corresponding to the LHF (1-3 GHz) in reactor-sized tokamaks, very powerful (approximately 0.5 MW, continuous wave) sources already exist. (2) The power may be transmitted to the plasma by means of waveguide, so that one has a "colleless" rf injection system. The characteristics of the rf produced plasma were studied to develop the parametric gap between the test devices and the ATC Tokamak. (auth)

**11618** (CONF-740642-, pp C7.1-C7.6) RF HEATING OF LOW PRESSURE GASES. Warder, R. C. Jr. (Univ. of Missouri, Columbia); Penfold, A. S. 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The plasma discharges surrounding a shielded solenoidal coil excited with current at 4 MHz have been investigated for helium, neon, nitrogen, argon, krypton and xenon in the pressure range 0.02 to 0.50 Torr. Measurements were made of various electrical properties including the operating power and the resistance and inductance reflected into the drive circuit by the discharges. Power levels up to 4000 watts were used. The value of reflected resistance behaves in a manner inconsistent with the observed changes in inductance when correlated through theory. The values of resistance exhibit only a slight dependence on pressure and current. (auth)

**11619** (CONF-740642-, pp D2.1-D2.8) PARAMETRIC INSTABILITIES AND PLASMA HEATING NEAR THE LOWER HYBRID FREQUENCY. Chang, R. P. H. (Bell Labs., Murray Hill, NJ); Porkolab, M. 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Experimental and theoretical studies of a new type of parametric instability involving the excitation of ion quasi-modes (due to nonlinear wave-particle scattering) have been carried out when the "pump" frequency is near the lower-hybrid frequency. Plasma heating associated with this instability has also been measured. (auth)

**11620** (CONF-740642-, pp D3.1-D3.6) EXPERIMENTAL STUDIES OF PLASMA HEATING ASSOCIATED WITH PARAMETRIC INSTABILITIES. Arunasalam, V.; Luhmann, N. C. Jr.; Porkolab, M.; Schmitt, J. P. M. (Princeton Univ., NJ). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Experimental studies of plasma heating due to microwave irradiation of the magnetically confined plasma column in the Princeton L-3 device will be presented. X-band microwave power, both in the ordinary and extraordinary modes of propagation, was used in these experiments. Plasma heating has been observed to occur simultaneously with parametric decay instabilities. The mode structure of the pump wave and the decay ion wave dispersion have been measured by high frequency probes. Measurement of both electron and ion heating rates will be presented and compared with collisional heating rates. The localization of plasma heating and mode structure are discussed. (auth)

**11621** (CONF-740642-, pp D6.1-D6.6) PARAMETRIC HEATING OF ELECTRONS BY AN ELECTROMAGNETIC WAVE. Carlile, R. N. (Univ. of Arizona, Tucson). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

In a computer simulation study, the parametric heating of electrons when an electromagnetic pump wave propagates through the plasma parallel to the dc magnetic field was observed. The heating mechanism is parametric excitation of resonant electrostatic waves which trap electrons. Consequently, the electron distribution function develops a high velocity tail. The details of these processes are discussed. It was found that the energy of the electrons will increase by a factor of about 4. It is determined that the distribution function after heating will relax to Maxwellian in about 11 electron-electron collision times. (auth)

**11622** (CONF-740642-, pp D8.1-D8.6) DAMPING OF THE FAST WAVE AND PLASMA HEATING BY AN UNIDENTIFIED MECHANISM. Dollinger, R. (Texas Tech Univ., Lubbock); Kristiansen, M.; Hagler, M. O.; Paoloni, F. J.; Bergstroem, J. 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Wave damping and plasma heating were observed for the fast (right-hand polarized) wave at a frequency below the second harmonic of the ion cyclotron frequency (OMEGA/sub i/) in a dense hydrogen plasma (n greater than $10^{20}$/m$^3$) in a mirror geometry. The wave is also observed to damp at the second harmonic. (auth)

**11623** (CONF-740642-, pp E2.1-E2.5) THEORY AND SIMULATION OF CYCLOTRON HEATING IN A LINEAR OCTUPOLE. Sprott, J. C. (Univ. of Wisconsin, Madison). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

A simple conductivity model is used to calculate the cyclotron heating rate (electron or ion) in an arbitrary nonuniform magnetic field. The result is applied to an ideal linear octupole field, which, because of its complexity, offers a severe test of the theory. The theory is compared with the results of a numerical simulation in which the trajectories and average energy of a collection of non-interacting particles are calculated as a function of time. The theory and simulation are in surprisingly good agreement over a wide range of heating frequency, plasma temperature, electric field strength, and wave number. (auth)

**11624** (CONF-740642-, pp E3.1-E3.6) ECRH EXPERIMENTS IN A TOROIDAL OCTUPOLE. Wong, K. L.; Sprott, J. C. (Univ. of Wisconsin, Madison). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Electron cyclotron heating rates were measured for low density plasmas (omega$^2$/sub p/ much less than omega$^2$) in a toroidal octupole by the sweep method with resonance zones situated near the minor axis of the toroid. The energy absorbed by the plasma from the 100 mW frequency sweep oscillator is determined from the broadening of the cavity modes. The heating rate is measured for different magnetic field strengths, electron temperatures, electron-neutral collision frequencies and plasma densities. The scaling of heating rate with plasma density is different from previous results of high frequency (10 GHz) cavity mode measurements. The difference is explained by the different positions of the resonance zones. (auth)

**11625** (CONF-740642-, pp E4.1-E4.6) ICRH EXPERIMENTS IN A TOROIDAL OCTUPOLE. Barter, J. D.; Sprott, J. C. (Univ. of Wisconsin, Madison). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

A 100 kW, 144 mu sec pulse of 1.4 MHz rf is used to heat plasmas with densities approximately less than $3 \times 10^{12}$ cm$^{-3}$ at the ion cyclotron frequency in a toroidal octupole. The rf is coupled to the plasma by a single turn, electrostatically shielded hoop coaxial to the four main hoops and located near the wall. Absorbed power is inferred from plasma loading of the hoop and measured directly with an electrostatic ion energy analyzer and compared to single particle resonance heating theory. (auth)

**11626** (CONF-740642-, pp E8.1-E8.6) DENSE RELATIVISTIC ELECTRON PLASMA BY ELECTRON CYCLOTRON HEATING AND ADIABATIC COMPRESSION AT THE INSTITUTE OF PLASMA PHYSICS, NAGOYA UNIVERSITY. Alexeff, I.; Ikegami, H.; Aikawa, H.; Okamura, S.; Hosokawa, M.; Aihara, S. 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The hot-electron plasma produced by resonant electron cyclotron heating was successfully used as a well-controlled initial phase for a subsequent slow compression experiment. The plasma electron temperature increased almost linearally with an increase of magnetic field up to a compression ratio of over 10:1. The initial value was about 10 keV, and the final value was about 110 keV. An important observation was that the compressed plasma appeared to be stable, even when the cold background plasma density decreased dramatically. (auth)

**11627** (CONF-740642-, pp E10.1-E10.7) RADIO-FREQUENCY ACTIVATED TWO-ENERGY-COMPONENT TOROIDAL FUSION REACTORS. Jassby, D. L. (Princeton Univ., NJ). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The maximum gain of a two-energy-component fusion reactor in which the hot component (D) is produced by rf heating is considered. In one ideal case, the fast wave at omega equals 2 omega /sub CD/ produces an energy distribution f(W) approximately constant that includes all deuterons, which then thermalize and react with the cold tritons. In another ideal case, f(W) approximately constant is maintained by the fast wave at omega equals omega/sub CD/. In either case, the maximum gain is comparable to that of the beam-injection scheme. When one includes unavoidable rf inputs to bulk-plasma electrons and tritons, and the probability that many deuterons remain cold, the gain is substantially less than that of the beam-injection scheme. (auth)

**11628** (IPPJ-200) ION CYCLOTRON HEATING OF A PLASMA AND ENERGY CONFINEMENT IN A TOROIDAL QUADRUPOLE. Takizuka, T.; Abe, H.; Momota, H.; Namba, C. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Sep 1974. 23p. INIS.

With the use of rf electric fields, the heating of the plasma and the improvement in the energy confinement are studied for an open-ended toroidal quadrupole. After analyzing loss mechanisms of the plasma and the heating rate, both theoretically and numerically, some optimizations have been made. The resultant heating and energy confinement are exhibited in the computer experiments. The plasma can be heated easily and the improvement in the energy containment time ~10% is obtained. (auth)

**11629** (JINR-P11-9113) MATHEMATICAL MODELING OF THE DYNAMIC THREE-DIMENSIONAL NONLINEAR PROBLEM OF THE PHYSICS OF WEAKLY TURBULENT PLASMA. II. Turbulent Heating of the Plasma by Electromagnetic (Laser) Radiation and Abnormal Scattering of the Radiation. Getmanov, H. S.; Makhan'kov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 17p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The problem of abnormal scattering of laser radiation on excited ion-sonic oscillations, leading to the study of the dynamics of ion-sonic turbulence with consideration of its angular distribution, was studied. Qualitatively it was shown and confirmed by numerical studies that the excited turbulence is weakly anisotropic and remains so all during the process of transfer of the oscillations into the long-wave region because of the induced scattering on ions; therefore the abnormal scattering is small. On the basis of the results obtained and results from previous studies it was concluded that the existence of isotropic spectra of weak turbulence in real conditions is problematic. (tr-auth)

**11630** (ORNL-tr-4027) ROLE OF IMPURITIES IN ANOMALOUS RESISTANCE OF PLASMA. Kirillov, V. D.; Trubikov, B. A.; Trushin, S. A. Translated by Martha Gerrard from Fiz. Plazmy; 1: No. 2, 218-237(1975). 24p. Dep. NTIS $4.50.

The process of deep ionization of heavy ion impurities in a discharge with increasing temperature, which permits determining the effective charge of the impurity ions, z/sub eff/ is considered. It is shown that the contribution to the resistance of the plasma is not only the coulomb collision of the electrons with ions of the impurities but also collision with electron shells of the ions. The results of numerical calculations of the concentrations of the impurities which may ensure the observed anomalies are described. There are five appendixes containing additional information on ionization, dispersion of electrons, and irradiation of impurities. The bremsstrahlung spectrum was calculated with consideration of the effect of the ion cores. (auth)

**11631** SPECTROSCOPIC INVESTIGATION IN THE TEXAS TURBULENT TOKAMAK. Rowan, W. L. Austin, TX; Univ. of Texas (1975). 130p. University Microfilms Order No. 75-24,950.

Thesis (Ph. D.).

The preheat plasma and the turbulently heated plasma produced in the Texas Turbulent Tokamak have been investigated using spectroscopic techniques. The temperature of the preheat plasma was found to exceed 9 eV. Molecular processes in the preheat are briefly discussed. The principal impurities in the turbulently heated plasma were identified and their densities measured. The electron temperature in the heated plasma was measured, and the possibility of a cold electron component coexisting with the hot component was investigated. (Diss. Abstr. Int., B)

**11632** GENERATION OF DEUTERIUM–TRITIUM NEUTRONS IN THE CASE OF SPHERICAL HEATING OF A SOLID TARGET BY EMISSION FROM A HIGH-POWER LASER. Basov, N. G.; Zakharenkov, Yu. A.; Krokhin, O. N.; Mikhaylov, Yu. A.; Sklizkov, G. V.; Fedotov, S. I. Kvantovaya Elektron. (Kiev); 1: No. 9, 2069-2071(1974). (In Russian)

The results are presented of time-of-flight measurements of the spectrum of neutrons formed during spherical heating of a $(CD_2)_n$ target by emission from a 9-channel laser installation. Neutron emission corresponding to the reaction D(t,n)He$^4$ is observed in the laser plasma. A method is proposed for determining the degree of plasma compression with respect to the ratio of numbers of DT- and DD-neutrons formed in the plasma. (Ref. Zh.)

**11633** CONFINEMENT OF A TOROIDAL PLASMA IN A MAGNETIC FIELD. Marcilhacy, G. (Paris-6 Univ., 75 (France). Inst. Henri Poincare). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 16, 505-507(28 Apr 1975). (In French)

A set of solutions of the MHD equations for a toroidal plasma with current distribution in the plasma itself is written in a toroidal coordinate system, instead of the usual cylindrical system. The confining magnetic field can be completely split into a poloidal and a toroidal field. (FR)

**11634** LASER FUSION. Bhawalkar, D. D. (Bhabha Atomic Research Centre, Bombay (India)) Phys. News; 5: No. 3, 92-95 (Sep 1974).

The principle of thermonuclear fusion is explained in brief. The problem of heating the D-T mixture to a very high temperature and producing inertial confinement of the plasma to bring about a substantial number of fusion reactions is discussed. The energy required is calculated to be $10^8$ joules at $10^{80}$K for a confinement time shorter than $10^{-9}$ secs., for solid densities of $n = 5 \times 10^{22}$. As the energy required to initiate fusion is reduced with the increase of density of the fuel mixture, attempts have been directed to compress the fuel by the use of lasers and at the same time ignite the mixture to a high temperature. The processes taking place when a laser pulse of a critical frequency is focussed on a spherical pellet of D-T mixture are described. Results of a typical computer calculation experiment are given on the required laser energy for initiating the chain of fusion reactions. Guidelines are given on the choice of the most suitable laser. Criteria governing the design of the fusion chamber for controlled fusion reactors are also discussed. Neodymium doped glass lasers are being developed in many laboratories at present to produce energy of the order of 10-100 kilo joules in a few nanosecs. It is hoped that the feasibility of the laser fusion will be proved before the end of this century. (INIS)

**11635** PLASMA HEATING BY A SHORT PULSE WIDTH RELATIVISTIC ELECTRON BEAM. Okamura, R.; Kawashima, N. (Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science). Phys. Lett., A; 54: No. 1, 101-102(11 Aug 1975).

A magnetized plasma column is effectively heated by the injection of a short pulse width (3 nsec) relativistic electron beam (500 keV, 2kA). It is found that the coupling efficiency of the beam energy into the plasma is optimum when the plasma density is appropriate. (auth)

**11636** PLASMA CONFINEMENT BY LOCALIZED MAGNETIC CUSPS. Leung, K. N. Los Angeles; Univ. of California (1975). 120p. University Microfilms Order No. 75-21,664.

Thesis (Ph. D.).

Magnetic confinement of a plasma is studied in a thin walled 24 liter chamber surrounded by external movable walls of magnetic dipoles. Full-line cusps were found to be the most effective arrangement, with an optimum spacing of 8 cm for the 24 liter vessel. Such a magnetic array improves the confinement of primary ionizing electrons by two orders of magnitude over a chamber without confinement, and improves ion confinement by a factor between 2 and 3. The details of cusp confinement were studied using a picket-fence (current produced line cusps). Results give additional evidence that the primary electrons are confined very efficiently by line cusps, with weaker confinement of plasma ions. Probe scans behind the picket-fence with helium, argon and xenon plasmas show that the half-width of the leakage aperture of plasma electrons through the line cusp is twice the hybrid gyroradius (r/sub e/r/sub i/)/sup $\frac{1}{2}$/ with r/sub e/ and r/sub i/ as the electron and ion gyroradii. This dependence differs from existing theories. The primary electrons are found to have leakage half-widths approximately equal to their gyroradii. Time evolution of the leakage widths are given. Steady state widths are reached in a time less than the ion gyro-period. (Diss. Abstr. Int., B)

# Plasma Diagnostics

**11637** (COO-2229-11) SPATIALLY RESOLVED INSTABILITY MEASUREMENTS WITH A HEAVY ION BEAM PROBE. Jennings, W. C.; Hickok, R. L.; Glowienka, J. C. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Plasma Dynamics Lab.). 1975. 4p. (CONF-750996-1). Dep. NTIS $4.00.

From seventh European conference on controlled fusion and plasma physics; Lousanne, Switzerland (1 Sep 1975).

A heavy ion beam probe was used to make simultaneous measurements of the amplitude and phase of both density and space potential fluctuations in an energetic arc plasma. Detailed comparison with theoretical predictions identifies a 70 KHz coherent oscillation as a Kelvin-Helmholtz instability localized to a region of strong fluid shear. (auth)

**11638** (COO-2444-1) ION BEAM PROBE DIAGNOSTIC SYSTEM FOR THE LITE EXPERIMENT. Stufflebeam, J. H.; Jennings, W. C.; Hickok, R. L. (Rensselaer Polytechnic Inst., Troy, N. Y. (USA). Plasma Dynamics Lab.). Nov 1974. Contract AT(11-1)-2444. 9p. Dep. NTIS $3.50.

The problem of defocusing of the ion beam by the strong gradients in the magnetic field was discussed. It was shown this can be overcome by a linear field lens to shape the initial beam, or by proper selection of the size and position of the secondary ion detector. The results of the preliminary beam alignment were presented and the favorable comparison of the scaling formula and computer simulation was evident. (auth)

**11639** (INR-P-1459/24/PP/C) INTERFEROMETRIC MEASUREMENTS OF HIGH-DENSITY PLASMA. Appelt, J.; Czaus, K.; Sadowski, M.; Ugniewski, S. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 24p. INIS.

The paper presents the main features of the Mach-Zehnder interferometer equipped with a pulsed ruby laser, that was used for measurements of electron concentration in a plasma produced by the F-20 coaxial injector. Interferograms of various stages of the discharge are presented, together with an appropriate time scale. A method of quantitative analysis of interferograms is described, and the results of computations are discussed. The results of measurements indicate that the F-20 injector is capable of producing a high-density plasma in the immediate vicinity of the end of the center electrode. The maximum density of the plasma is of the order of $10^{19}$ $cm^{-3}$. At the moment just before the peak compression, the region having plasma density higher than $10^{18}$ $cm^{-3}$ is about 1.0 cm in length and less than 0.4 cm in radius. (auth)

**11640** (ORNL-tr-4047) NEW METHOD FOR LOCAL MEASUREMENT OF THE EFFECTIVE CHARGE AND THE ION DENSITY IN A TOKAMAK. Dei-Cas, R. Aug 1975. Translation of EUR-CEA-FC-775. 15p. Dep. NTIS $4.50.

A new method is proposed to measure the local effective charge and the local ion density in a tokamak plasma. The method is based on the measurement of the local captured fraction of a fast neutral beam injected. (auth)

**11641** (UCRL-77075) COMPUTER ANALYSIS OF FOUR CHANNEL X-RAY MICROSCOPY IMAGES TO OBTAIN SOURCE AND SPECTRAL EMISSION DATA ON LASER FUSION. Harper, T. L. (California Univ., Livermore (USA). Lawerence Livermore Lab.). 6 Oct 1975. Contract W-7405-Eng-48. 29 p. (CONF-751130-13). Dep. NTIS $5.00.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

It is possible to analyze the images obtained from the four-channel x-ray microscope to obtain reasonable estimates of source spatial and energy emission. The technique shown here is particularly useful when relative comparisons are desired in which, from shot to shot, few parameters are changed. These data are of use in Fuel pellet design and in checking design code predictions. The technique should also apply to pinhole camera data. Largest uncertainties appear to be due to film energy/handling calibration and mirror efficiency measurements. (auth)

**11642** (UCRL-77173) ACTIVATION MEASUREMENTS OF HIGH ENERGY DEUTERONS IN THE PLASMA FOCUS DEVICE. Gullickson, R. L.; Sahlin, H. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 4 Dec 1975. 18p. (CONF-751130-17). Dep. NTIS $3.50.

From ASP meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Nuclear activation techniques were used to measure the fluence of high energy deuterons in a plasma focus device having a stored energy of 75 kilojoules at 18 kV. The $^{12}C(d,n)^{13}N$ (330 keV threshold) and $^{27}Al(d,p)^{28}Al$ reactions were used to provide both an absolute number of high energy deuterons and an average energy, evaluated from the $^{13}N/^{28}Al$ ratio calculated for various energies by Young. Previous measurements indicated more than $10^{15}$ deuterons could be accelerated to energies above 330 keV in the low pressure mode of operation, with a highly anisotropic distribution. Present measurements show that more than $10^{12}$ deuterons achieve energies greater than 5 MeV on some high intensity shots in the low pressure mode. The presence of multi-MeV deuterons in the plasma focus device was substantiated by measuring activation as a function of depth in 1 mil Al foils, and by measurements of neutron energy using time-of-flight. (auth)

**11643** PULSED HF LASER HOLOGRAPHIC INTERFEROMETRY. Kristal, R. (Los Alamos Scientific Lab., NM). Appl. Opt.; 14: No. 3, 628-633(Mar 1975).

Two-dimensional holographic interferometry has been accomplished at wavelengths near 3 mu m. The source is a pulsed hydrogen fluoride oscillator-amplifier system. Transverse excitation is achieved with a fast bank discharging into a simple electrode configuration. The spatial detector is a thin film of bismuth, exposed by local evaporation by a single line of the HF laser emission spectrum. Double exposure interferograms covering areas up to approximately 10 $cm^2$ in the object plane have been obtained with single-line laser energies of less than a joule. (auth)

**11644** MEASURING METHODS FOR STUDYING THE PLASMA IN THE TOKAMAK T.F.R. Etievant, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Bull. Inf. Sci. Tech. (Paris); No. 202, 31-47(Apr 1975). (In French)

The diagnostics in operation or still under development in order to study the main parameters of the plasma of TFR is reviewed: electron and ion temperatures, current density, electrical behavior of the discharge, densities of neutral gas and of impurities; parameters of plasma turbulence. (FR)

**11645** DATA ACQUISITION AND PROCESSING ON T.F.R. USING A MINICOMPUTER. Hennion, F.; Idmtal, J.; Touche, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Bull. Inf. Sci. Tech. (Paris); No. 202, 49-53(Apr 1975). (In French)

Certain experimental TFR data are digitalized and may be acquired by a Telemecanique Electrique T 2000 computer. These data are stored on magnetic tapes and can be treated on line. The signals from direct measurements or calculation results are plotted on a visual display screen located on the experimental site, which means that the main parameters of the experiment can be known immediately after the collision. (FR)

## Plasma Kinetics (General)

**11646** (CONF-741040-P1, pp 253-258) ATOMIC AND NUCLEAR CROSS SECTION NEEDS FOR THE CONTROLLED THERMONUCLEAR RESEARCH PROGRAM. Barnett, C. F. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Specific atomic and nuclear physics problems related to controlled fusion research are reviewed. In atomic physics problem areas to be discussed are as follows: plasma diagnostics, plasma heating, and cooling. Areas needing numerical nuclear data are charged particle reactions involving advanced fuel cycles and cross sections for 14 MeV neutrons. (auth)

**11647** (INR-P-1456/7/PP/C) INVERSION OF HYDROGEN LEVEL POPULATIONS IN STATIONARY PLASMAS. Skorupski, A.; Suckewer, S. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 9p. INIS.

Large inversions in the two-temperature stationary hydrogen plasma are obtained by solving balance equations with ion-atom and atom-atom collisions taken into account. (auth)

## Plasma Kinetics (Experimental)

**11648** (CONF-740642-, pp E5.1-E5.7) ANAMALOUS RESISTIVITY DUE TO INTERMEDIATE-FREQUENCY FIELDS. Conrad, J. R.; Gore, R.; Lashinsky, H. (Univ. of Maryland, College Park). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The production of anomalous resistivity in a Q-machine plasma by a large amplitude, longitudinal rf electric field is described. Noncontact diagnostics have been developed to measure the longitudinal and azimuthal components of the resistivity. The implication of these measurements with regard to proposed "catalytic heating" of toroidal plasmas is described. (auth)

**11649** ION ENERGY SPECTRUM IN THE TEXAS TOKAMAK. Parsons, C. R. Austin, TX; Univ. of Texas (1975). 109p. University Microfilms Order No. 75-24,935.

Thesis (Ph. D.).

The Texas Tokamak is a toroidal plasma device designed to study the turbulent heating and confinement of plasma. To determine the ion temperature, the energy distribution of the charge exchange neutrals escaping the plasma was measured. Charge exchange neutrals leaving the plasma through a small port in the vacuum vessel pass through a helium stripping cell where a fraction of them are ionized. The energies of the resulting beam of ions were analyzed in a $127^0$ electrostatic energy monochrometer. The current from the energy analyzer was collected and amplified with a Daly detector. The resulting energy spectra yielded information about the ion temperature and the fractional population of ions that were heated as a function of tokamak parameters such as total plasma density and the charging voltage of the turbulent heating capacitor bank. This experiment revealed that a fraction of the plasma ions were heated to temperatures of 2000 to 5000 electron volts. (Diss. Abstr. Int., B)

**11650** ELECTRIC AND SPECTROSCOPIC PROPERTIES OF THE RADIOFREQUENCY PLASMA IN A STEADY MAGNETIC FIELD. Moraru, D. (Research and Development Institute for the Electrical Industry, Bucuresti (Romania)). Beitr. Plasmaphys.; 13: No. 1, 47-62(1973).

In the experiments carried out on the capacitively excited high-frequency helium discharges at pressures of $10^{-3}$–$10^{-2}$ Torr, spectral line redistribution in the helium spectrum as a function of applied steady magnetic field magnitude has been observed. The magnetic field application modifies also the plasma dispersive properties, which are reflected in the variable relative weight of the h.f. field harmonics. (auth)

**11651** OPTICAL ESCAPE FACTORS FOR BOUND-BOUND AND FREE-BOUND RADIATION FROM PLASMAS. Pt. 1. Constant Source Function. Drawin, H. W.; Emard, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Beitr. Plasmaphys.; 13: No. 3, 143-168(1973).

Optical escape factors for bound-bound and free-bound radiation have been calculated by solving the equation of radiative transfer with the assumption that the corresponding source functions are space-independent. The general expression for bound-bound transitions yields for large optical depths Holsteins asymptotic expressions for the two limiting cases of a Doppler and a dispersion profile. Application to the more general case of a Voigt profile leads to an analytical formula which permits a rapid estimate of the escape factor for any optical depth. Numerical application to the resonance lines of neutral helium shows that under certain plasma conditions most of the higher members of the resonance series remain optically thin. The general expression obtained for the escape factor of free-bound radiation has been applied to the resonance continuum of neutral helium. (auth)

**11652** TIME DISTRIBUTION OF ELECTRON TEMPERATURE IN A CHANNEL AND AT A SECTION OF A PULSED ELECTROMAGNETIC ACCELERATOR. Ivanova, L. E. Zh. Prikl. Spektrosk.; 23: No. 1, 19-23(Jul 1975). (In Russian).

The time distributions of electron temperatures in a channel and at a section of a pulsed electromagnetic accelerator of the erosion type ($C_0$ = 1500 uF, U = 3 to 5 kV, $I_{max}$ = 300 to 500 kA, $L_0$ = 50 nH) are presented. The discharge time (from 6 to 33 msec) electron temperature remains approximately constant in time, which indicates a quasi-stationary regime of accelerator operation. The average value of $T_e$ obtained from scans in the base discharge time and the value of $T_e$ obtained for these same points by integration in time agree with a precision of 8%. (tr-auth)

**11653** EXPERIMENTAL STUDY OF RUNAWAY ELECTRONS AND PLASMA RESISTIVITY IN A PLASMA BETATRON. Grossman, M. W. New York; City Univ. of New York (1975). 212p. University Microfilms Order No. 75-21,327.

Thesis (Ph. D.).

A plasma betatron has been constructed to study runaway electrons and plasma electrical resistivity in a magnetized toroidal plasma. The 40 KHz betatron induction field has a maximum amplitude which can be varied from 1.5 V/cm to 12.5 V/cm. The azimuthal magnetic field has an amplitude in the range of 300 gauss to 2000 gauss and is essentially constant during the time of plasma formation and application of the betatron field. Ionization rates by runaways were studied by the direct summation of the number of electrons produced in an ionizing cascade. Also, certain parametric relations among the external fields and the total runaway current are found. (Diss. Abstr. Int., B)

## Plasma Kinetics (Theoretical)

*Refer also to abstracts 12987 and 13120.*

**11654** (JINR-P11-9112) MATHEMATICAL MODELING OF THE DYNAMIC THREE-DIMENSIONAL NONLINEAR PROBLEM OF THE PHYSICS OF WEAKLY TURBULENT PLASMA. I. Getmanov, B. S.; Makhan'kov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

The dynamics of weak anisotropic Langmuir turbulence, excited by a relativistic electron beam and determined by processes of induced scattering on ions, were modeled by numerical methods. It was found that in the process of evolution the distribution of the wave with respect to the scattering angle becomes symmetrical with respect to pi/2 but remains sharply anisotropic. The latter effect was illustrated by graphs of the behavior with time of the function of anisotropy. The

possibility of nonlinear stabilization of the instability was illustrated. (tr-auth)

**11655** (MATT-1177) TWO NEW PROOFS OF THE TEST PARTICLE SUPERPOSITION PRINCIPLE OF PLASMA KINETIC THEORY. Krommes, J. A. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 28p. Dep. NTIS $4.00.

The test particle superposition principle of plasma kinetic theory is discussed in relation to the recent theory of two-time fluctuations in plasma given by Williams and Oberman. Both a new deductive and a new inductive proof of the principle are presented. The fundamental observation is that two-time expectations of one-body operators are determined completely in terms of the (x,v) phase space density autocorrelation, which to lowest order in the discreteness parameter obeys the linearized Vlasov equation with singular initial condition. For the deductive proof, this equation is solved formally using time-ordered operators, and the solution then rearranged into the superposition principle. The inductive proof is simpler than Rostoker's, although similar in some ways; it differs in that first order equations for pair correlation functions need not be invoked. It is pointed out that the superposition principle is also applicable to the short-time theory of neutral fluids. (auth)

**11656** (UCID-16973) RADIATIONALLY-INDUCED RADIAL CONTRACTION OF Z-PINCHES. Shearer, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-Eng-48. 32p. Dep. NTIS $5.00.

A one-dimensional calculation of the radial motion of a Z-pinch was based on the Bennett relation, ohmic heating, and radiation loss. The result shows that the pinch will shrink if its current exceeds the Pease–Braginskii current (.1–1.5 megamps, depending on the radial density distribution and the impurity level), and if the shrinkage rate exceeds the growth rate of instabilities. It is suggested that the approximately 0.1 mm x-ray sources observed in plasma focus experiments are produced by this mechanism. (auth)

**11657** (UCRL-77149) ENERGY FLUX LIMITATION BY TAME TURBULENCE. Manheimer, W. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-eng-48. 19p. (CONF-751130-7). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

A quasi-linear theory of energy flux limitation by ion acoustic turbulence is presented. This distribution function is modelled by a Maxwellian plus an additional piece which carries a heat flux Q. By taking the fourth moment of the Vlasov equation one finds the anomalous thermal conductivity K approximately 3 v/sub e/ delta/sub De/ (e phi/T/sub e/)$^{-2}$. Other moments treated self-consistently include anomalous ion heating, electron cooling, current generation and enhanced inverse bremsstrahlung due to the nonthermal ion fluctuations. (auth)

**11658** (UCRL-77168) NONTHERMAL EFFECTS IN TWO COMPONENT DT FUSION REACTORS. Weaver, T. A.; Chu, T. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 7 Nov 1975. 12p. (CONF-751130-16). Dep. NTIS $3.50.

From ASP meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Net energy generation rates and f-factors are calculated for a variety of two component DT reactor configurations using a computer code that follows the energy distributions of the reactants and products explicitly, utilizing the Fokker–Planck approximation for low-angle Coulomb scattering and a transfer matrix for high-angle Coulomb, nuclear, and radiative processes. The relative importance of such non-thermal effects as alpha particle deposition, non-Maxwellian energy distributions for the target tritons and electrons, and the influence of high-angle Coulomb and nuclear scattering on the energy loss rate of the injected deuterons is explicitly assessed. (auth)

**11659** ELECTRON SCREENING CORRECTIONS IN DENSE IONIZED MATTER. Hansen, J. P. (Paris-6 Univ., 75 (France)). J. Phys. (Paris), Lett.; 36: No. 5, L.133-L.135(May 1975).

Thermodynamic perturbation theory is used to calculate the corrections to the free energy and equation of state of the one-component plasma, due to the polarization of the electron background. (FR)

**11660** NON-AXISYMMETRIC TOROIDAL TRANSPORT AND PLASMA ROTATION. Tsang, K. T. Princeton, NJ; Princeton Univ. (1974). 139p. University Microfilms Order No. 75-23,247.

Thesis (Ph. D.).

An expression was calculated for parallel ion flow in general nonaxisymmetric geometry, both in fluid and banana regime. Ambipolar conditions in these regimes are obtained from the ion flux. A relaxation which is quite different from the classical viscosity effect is thus derived. This relaxation however resembles the coupling between the radial temperature gradient and the relaxation of parallel ion flow obtained by Rosenbluth et al., in banana regime of an axisymmetric system. When the nonaxisymmetry becomes smaller and smaller, the relaxation of parallel ion velocity then comes from the quasi-neutrality requirement on the higher order fluxes. The nonaxisymmetric effect is mixed with the axisymmetric effect. As a basis of the calculation, the axisymmetric calculation of Rosenbluth et al., for banana regime is extended to intermediate and fluid regime. A small perturbation to this axisymmetric result is obtained by including a higher order non-ambipolar flux in the calculation. Final result shows that an exponential type relaxation term should be added to the axisymmetric equation if there are small ripples on the tokamak field. This term may be significant for a large machine such as PLT. (Diss. Abstr. Int., B)

**11661** PARTICLE ORBIT APPROACH TO THE SOLUTION OF VLASOV-REGIME PLASMA PROBLEMS. Hyde, R. S. University Park, PA; Pennsylvania State Univ. (1975). 96p. University Microfilms Order No. 75-22,685.

Thesis (Ph. D.).

A new technique for the solution of Vlasov-regime plasma problems is investigated. For simplicity, only the case of an infinite, quasi-static, electron plasma in the absence of an external field is treated in detail. The first-order, ordinary perturbation theory that is developed here is based on an expansion of the equation of motion for the electron orbit function and Poisson's equation for the self-consistent electric field. The equation of motion for the first order orbit correction is used to construct the kernel in the Fourier transformed Poisson equation. This is in contrast to the more typical approach based on an expansion of the Vlasov equation for the single particle, phase space distribution function. While the two different approaches must yield equivalent results, it is found that the intuitive appeal of the orbit-function approach provides an insight into plasma problems that is often lacking in the Vlasov equation approach. Specific application is first made to the case where the zero-order state is homogeneous. The well-known dispersion relation for a homogeneous plasma is readily obtained. As a second application, the case of a spatially periodic zero-order state is considered. The particular problem where the zero-order electric field is sinusoidal and stationary in the waveframe is discussed in detail. The dispersion relation previously obtained by Kruer, et al., (1969) and Goldman (1970) for the sideband instability is obtained without difficulty by limiting the analysis to include only the strongly trapped electrons and the non-resonant untrapped electrons. It is found that if the analysis is generalized to include electrons with more complicated orbits, the kernel obtained from formal solution of the first-order equation of motion is too complicated for direct use. It is shown that, if only information about the electric field is required, direct use of the orbit equation is unnecessarily awkward. The dispersion relation for the sideband instability is reduced to quadratures in the case where more general trapped electron orbits are considered. (Diss. Abstr. Int., B)

**11662** ADIABATIC EVOLUTION OF PLASMA EQUILIBRIUM. Grad, H.; Hu, P. N.; Stevens, D. C. (New York Univ., NY). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 10, 3789-3793(Oct 1975).

A new theory of plasma equilibrium is introduced in which adiabatic constraints are specified. This leads to a mathematically nonstandard structure, as compared to the usual equilibrium theory, in which prescription of pressure and current profiles leads to an elliptic partial differential equation. Topologically complex configurations require further generalization of the concept of adiabaticity to allow irreversible mixing of plasma and magnetic flux among islands. Matching conditions across a boundary layer at the separatrix are obtained from appropriate conservation laws. Applications are made to configurations with planned islands (as in Doublet) and accidental islands (as in Tokamaks). Two-dimensional, axially symmetric, helically symmetric, and closed line equilibria are included. (auth)

**11663** PARAMETRIC RESONANCE IN COLD PLASMA IN THE PRESENCE OF THE ISOLATED ION VELOCITY. Machabeli, G. Z.; Tskhakaya, D. D. pp 89-94 of Fizika Plazmy. Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). (In Russian)

The paper is devoted to the magnetoactive plasma, the ions of which are rotating in one phase with each other along the Larmor circles of the definite radius. The Larmer orbits are distributed in space randomly. The principle possibility of the existence of the instability of such plasma is shown. (auth)

## Plasma Production

**11664** (CONF-740642-, pp C4.1-C4.5) BEHAVIOR OF A BOUNDED PLASMA INSIDE A MICROWAVE CAVITY AT HIGH

AND LOW PRESSURES. Asmussen, J. Jr.; Hawley, M. C.; Mallavarpu, R.; Mertz, S. (Michigan State Univ., East Lansing). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The design of a large-volume, versatile, efficient microwave plasma source is described. The source consists of a quartz tube surrounded by a cylindrical, variable-length cavity which is connected to a microwave power source. The lossy plasma-cavity eigenfrequencies are computed as functions of plasma density, effective collision frequency and cavity length. The circuit performance of the plasma-cavity system is qualitatively explained based on these eigenfrequency calculations. Experimental results demonstrate that a variable, high-density plasma with densities in excess of 1000 critical densities can be sustained. By adjusting cavity length and coupling, microwave plasmas can be sustained in flowing and nonflowing argon gaseous environments from pressures of several microns to over one atmosphere. Applications of this plasma source in two areas are described: (1) plasma chemistry experiments and (2) parametric instabilities under the influence of strong rf electric fields. (auth)

**11665** STUDY OF A HIGH PRESSURE DISCHARGE IONIZED BY A HIGH ENERGY ELECTRON BEAM. Allis, W. P. (Office National d'Etudes et de Recherches Aerospatiales (ONERA), 92 - Chatillon (France)). Rev. Phys. Appl.; 10: No. 3, 97-103(May 1975). (In French)

The ultimate objective of this study is a detailed knowledge of the plasma structure in an electron beam ionization laser. In the first part the ambipolar ($n_+ = n_-$) of the plasma was considered taking into account the uniform source S, the autonomous ionization $\nu_i n$, the recombination $\alpha n^2$, the attachment $\beta n$, the diffusion $D_a \Delta^2 n$, and an applied current J, all coefficients being constant. Thus, closed formulas for the electron density n(x) was obtained and the characteristic V(J) of this part of the plasma. In the usual conditions for applications, the continuous current J is not provided by the source S but the cathode emission $\gamma J_+$. In the second part a new theory of the cathode drop was developed which does not rest on the Townsend coefficient $\alpha_i$. The ionization i(V) was deduced from the electron flux $\Phi(u,V)$ in the space of kinetic u and potential V(x) energies. The first order differential equation for the flux $\Phi$ depends on the elastic, unelastic and ionization cross sections Q(u), and as these are experimental the resolution requires a computer. This is in preparation. (FR)

**11666** ABSORPTION OF LASER RADIATION IN CONTINUOUS AND DISCRETE PLASMA SPECTRA. Burakov, V. S.; Bokhonov, A. F.; Zhukovskii, V. V.; Naumenkov, P. A.; Nechaev, S. V. Zh. Prikl. Spektrosk.; 23: No. 1, 30-34(Jul 1975). (In Russian).

The absorption capacity of a plasma formed in a glass-textolite capillary, with zoning by a neodymium laser, is described. The main fraction of the laser radiation was given up to the bound-free and bound-bound transition of silicon atoms. The plasma transparency increased with increase in the laser beam current, $I > 10^8$ W/cm$^2$. Solution of a system of kinetic equations qualitatively confirmed that the observed experimental dependence of the nonlinearity of the absorption capacity of the medium is due to disruption of the local thermodynamic equilibrium in the perturbed plasma. (tr-auth)

**11667** RECORDING LOW-INTENSITY NEUTRON FLUXES FROM A SHORT-LIVED PLASMA. Volobuev, I. V.; Gorbunov, D. N.; Granatkin, B. V.; Isakov, A. I. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 401-403(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 65-66(1975).

A series of high-sensitivity scintillation detectors having an efficiency right up to 0.45 has been designed for recording neutrons from a laser plasma. The parameters of the diffusion of thermal neutrons, which are required to calibrate the detectors with the corresponding scintillators, were measured in polystyrene and white alcohol. (auth)

**11668** PLASMAS AND LASER LIGHT. Hughes, T. P. New York; John Wiley and Sons (1975). 528p.

The following chapters are included: (1) small-amplitude waves in a plasma, (2) radiative energy transfer, (3) incoherent scattering of light by plasmas, (4) thermonuclear reactions, (5) ionization and breakdown of gases by light, (6) plasmas formed by light in gases, (7) theory of plasmas formed by light incident on solids and (8) experimental studies of plasmas formed by light incident on solids. (MOW)

# Plasma Stability

*Refer also to abstracts 11619, 11621, and 11730.*

**11669** (CONF-740642-, pp D4.1-D4.6) PARAMETRIC INSTABILITY INDUCED IN A MULTISPECIES PLASMA BY MAGNETOSONIC WAVES. Sperling, J. L.; Perkins, F. W. (Princeton Univ., NJ). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Magnetosonic waves propagating near an ion gyrofrequency or the sum of the ion gyrofrequencies of a multispecies plasma can excite parametric instabilities due to relative ion motion. Although both the decay and purely growing instabilities may be excited, the decay instability into two electrostatic ion cyclotron waves with k/sub perpendicular/rho/sub i/ much greater than 1 leads to the lowest thresholds. The effect of density gradients and inhomogeneous magnetic fields on the threshold is discussed. (auth)

**11670** (CONF-740642-, pp D7.1-D7.6) SATURATION OF THE PARAMETRIC ION ACOUSTIC DECAY INSTABILITY IN ISOTHERMAL PLASMAS. Flick, J. T.; Hendel, H. W. (Princeton Univ., NJ). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Saturation measurements are reported on the isothermal parametric ion acoustic decay instability, driven by a coherent pump field (omega$_0$ approximately omega/sub pe/). Saturation $E^2$/sub inst/ approximately $E_0^2$ occurs without significant changes in instability spectra and wavelengths (no cascading), in agreement with a theory that includes the effect of nonlinear interactions between comparable pump and instability field intensities. The significance of this result with regard to instability-generated anomalous resistivity and pump depletion effects is discussed. (auth)

**11671** (ORNL-tr-4030) DEVELOPMENT OF A HELICAL MHD INSTABILITY. Gerlakh, N. I.; Sueva, N. M.; Morozov, A. I.; Solov'ev, L. S. (AN SSSR, Moscow). 1975. Translated by M. Gerrard from Preprint No. 74. 22p. Dep. NTIS $4.50.

The development of a helical instability, in time, in a plasma torus is examined by means of a numerical solution of the equations of ideal magnetohydrodynamics with a fixed plasma boundary. It is shown that for plasma with a high conductivity this process leads to formation of a filamentous structure of the magnetic surface. (auth)

**11672** DISSIPATIVE TRAPPED ELECTRON INSTABILITY IN CYLINDRICAL GEOMETRY. Prager, S. C. Columbia, NY; Columbia Univ. (1975). 90p. University Microfilms Order No. 75-25,712.

Thesis (Ph. D.).

The dissipative trapped electron instability poses a threat to plasma confinement in a toroidal fusion reactor. The instability was studied experimentally and theoretically in a cylindrical geometry. Consideration of a cylindrical, rather than toroidal, geometry makes an experiment feasible and facilitates the mathematical treatment and physical understanding of the instability. The growth rate and axial wave structure were derived for a finite cylindrical system with two axially localized magnetic mirrors. The growth rate can be larger than 10 percent of the wave frequency, which is approximately the diamagnetic drift frequency. A simple detailed description of the essential excitation mechanism of the instability, as it exists in either a cylinder or torus, is provided. Based on this physical and mathematical justification, an experiment was performed in a cylindrical machine in which the dissipative trapped electron instability was definitively identified through the dependence of wave amplitude on mirror ratio, axial position, electron temperature gradient, electron collision frequency and radial position. The wave travels in the electron diamagnetic drift direction with aximuthal mode number 1 and is nearly monochromatic at about 50 khz., which is in the neighborhood of the drift frequency. The density fluctuation in the wave can be as high as 30 percent. (Diss. Abstr. Int., B)

**11673** BEAM INSTABILITY IN THE CASE OF SHARP CHANGES IN PLASMA DENSITY. Amein, W. H.; Dologopolov, V. V.; Hussein, A. M.; Zayed, K. E. (Atomic Energy Commission, Cairo (Egypt)). Physica; 79: No. 6, 628-631(1975).

The authors investigate amplification of waves in the case when the beam propagates perpendicularly to the boundary at which

plasma density changes abruptly. Expressions are found which link wave amplitudes on both sides of the boundary. In the general case of obliquely incident waves, the fluctuations of surface-charge density of the type of surface waves arise at the boundary. These fluctuations cannot be resonantly excited by the beam propagating perpendicularly to the boundary. (auth)

**11674** A SUFFICIENT CONDITION FOR INSTABILITY OF BGK-TYPE WAVES. Infeld, E.; Rowlands, G. (Institute of Nuclear Research, Warsaw (Poland)). Phys. Lett., A; 54: No. 1, 106-108(11 Aug 1975).

By investigating three dimensional perturbations, a sufficient condition for instability of BGK waves is found. New perturbed modes, having no counterpart in a linear plasma, are also found. Known results are discovered in various limits. (auth)

**11675** IONIZATION WAVE AS AN INSTABILITY: EVOLUTION AND NONLINEAR EFFECT. Sato, M. (Yamagata Univ. (Japan)). Beitr. Plasmaphys.; 13: No. 1, 9-25(1973).

Evolution from the linear growth to the nonlinearly saturated state of ionization waves is investigated from a viewpoint of an instability which appears in a plasma. The experiments were performed observing backward waves excited below the upper critical current $I_c$ in xenon, argon, and argon-mercury gases at pressures of the order of one torr. It is found that the behavior of the evolution obeys the Landau amplitude equation; the saturated amplitude does not depend on an initial value, but only on plasma parameters; the linear growth and squared saturation level are proportional to the excess over $I_c$, and when frequency controlled, they have a parabolic dependence on the frequency; nonuniform axial changes in the dc state due to the nonlinear effects appear in a form of enhanced ionization in the plasma where the electron temperature and density are increased. (auth)

**11676** BEAM INSTABILITY DRIVEN BY A NONLINEAR LANGMUIR WAVE IN AN INHOMOGENEOUS PLASMA. Karpman, V. I.; Istomin, Ya. N.; Shklyar, D. R. (Izmiran, Moscow Region, USSR). Phys. Lett., A; 54: No. 2, 183-185(25 Aug 1975).

By taking into account the self-consistent evolution of a nonlinear Langmuir wave in an inhomogeneous plasma, beams formed by the detrapped particles are investigated. The frequency interval of the beam instability and amplification rates are calculated. (NL)

**11677** PARAMETRIC EXCITATION OF RELATIVISTIC PLASMA OSCILLATIONS BY STRONG ELECTROMAGNETIC WAVES. Ferrari, A.; Trussoni, E.; Zaninetti, L. (Turin Univ. (Italy). Istituto di Fisica). Phys. Lett., A; 54: No. 2, 186-188(25 Aug 1975).

Parametric interaction of strong waves ($f = eE_0/m_e C\omega_0 \sim 1$) with a cold, two-fluid (ion and electron) plasma is studied in the limits of high frequency ($\omega_0 \gg \omega_{Le}$) and resonance ($\omega_0 \sim \omega_{Le}$). Unstable oscillations of both electrons and ions are found in the resonance limit. (NL)

# Thermonuclear Engineering and Equipment

*Refer also to abstracts 11911 and 13913.*

**11678** (ANL/HEP-CP-75-70) PURE TENSION SUPERCONDUCTING TOROIDAL-FIELD COIL SYSTEM DESIGN STUDIES FOR THE ARGONNE EXPERIMENTAL POWER REACTOR. Wang, S. T.; Purcell, J. R.; Demichele, D. W.; Turner, L. R. (Argonne National Lab., Ill. (USA)). Nov 1975. Contract W-31-109-Eng-38. 6p. (CONF-751125-77). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

As part of the Argonne Tokamak Experimental Power Reactor (TEPR) design studies, a toroidal field (TF) coil system has been designed. NbTi was chosen as the most suitable superconductor and 8T was regarded as a practical peak field level in this study. The 16-coil design was chosen as a reasonable compromise between 2 percent field ripple and 3 m access gap. To minimize the coil structure and the bending moments on the conductor, a pure tension coil shape is necessary. A correct approach for determining the pure tension coil profile in a bumpy TF coil system is given. Verification of the pure tension coil by a three-dimensional stress analysis is presented. For coil quench protection, a series-connected scheme is proposed. (auth)

**11679** (BNL-20713) THERMAL DESIGN AND ANALYSIS OF STEADY STATE GRAPHITE BLANKETS. Fillo, J. A.; Powell, J. R. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. Contract E(30-1)-16. 16p. Dep. NTIS $4.50.

A description is given of the graphite blanket design for either an experimental power reactor or commercial reactor. A thermal analysis was made of the blanket. It is shown that the introduction of a low conductivity surface layer permits one to go to higher first wall loadings for commercial reactors. (MOW)

**11680** (BNL-20760) CALCULATIONAL MODEL AND DATA FOR CTR NEUTRONICS AND PHOTONICS. Maynard, C. (Brookhaven National Lab., Upton, N. Y. (USA)). Sep 1974. Contract E(30-1)-16. 18p. Dep. NTIS $4.50.

The following topics are discussed: (1) results required for CTR design and analysis, (2) calculational methods and computer programs exclusive of data, and (3) nuclear data and its processing. (MOW)

**11681** (CONF-740642-, pp C6.1-C6.3) GENERATION OF DC TOROIDAL CURRENT BY A TRAVELLING WAVE. Matsuura, K. (Nagoya Univ., Japan); Fukuda, M.; Hirano, K.; Mohri, A.; Fukao, M.; Midzuno, Y. 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

An rf field travelling along the torus is observed to induce a dc toroidal current in a magnetized plasma. The travelling field is applied to the plasma by employing a delay-line wound around the toroidal glass discharge tube. The phase velocity of the field is approximately equal to the electron thermal velocity. The direction of the current is opposite to that of the wave, indicating that the electrons are trapped in the magnetic mirrors composed of the travelling wave. The density of the trapped electrons reaches 10 percent of the background plasma density at an optimum condition. On the basis of the electron trapping model, the required rf power for current sustaining in a Tokamak fusion reactor is estimated and found to be reasonably small in comparison with the output power of the reactor. (auth)

**11682** (CONF-741040-P1, pp 224-232) USE OF HIGH POWER PARTICLE BEAMS IN FUSION RESEARCH. Schilling, G. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Particle beams charged and neutral, with energies from 1 to several hundred keV and currents from 0.1 to several hundreds of amperes, pulsed for a few msec to DC, are being used or their use planned for controlled thermonuclear fusion research. Applications include the heating and fueling of plasmas in present experimental devices toward reactor conditions, the ignition, fueling, and control of future fusion power reactors, the production of high-flux 14 MeV neutrons for reactor wall material radiation damage studies, sustaining a fusion engineering reactor device to study wall materials, and direct simulation of charged and neutral particle bombardment of reactor walls. (auth)

**11683** (CONF-741040-P1, pp 233-240) ADVANCED FUELS FOR NUCLEAR FUSION REACTORS. McNally, J. R. Jr. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Should magnetic confinement of hot plasma prove satisfactory at high beta (16 pi nkT/$B^2$ greater than 0.1), thermonuclear fusion fuels other than D-T may be contemplated for future fusion reactors. The prospect of the advanced fusion fuels D-D and $^6$Li-D for fusion reactors is quite promising provided the system is large, well reflected and possesses a high beta. The first generation reactions produce the very active, energy-rich fuels t and $^3$He which exhibit a high burnup probability in very hot plasmas. Steady state burning of D-D can ensue in a 60 kG field, 5 m reactor for beta approximately 0.2 and reflectivity R/sub mu/ equals 0.9 provided the confinement time is about 38 sec. The feasibility of steady state burning of $^6$Li-D has not yet been demonstrated but many important features of such systems still need to be incorporated in the reactivity code. In particular, there is a need for new and improved nuclear cross section data for over 80 reaction possibilities. (auth)

**11684** (CONF-741040-P1, pp 241-252) UTILIZATION OF A SMALL ACCELERATOR FOR FUSION REACTOR BLANKET DESIGN. Draper, E. L. Jr.; Parish, T. A.; Etzion, M. (Univ. of Texas, Austin). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

In order to provide integral tests of differential nuclear data and evaluate calculational methods used for fusion reactor design, a series of large volume benchmark experiments has been initiated. The first of these experiments used graphite as the matrix to be evaluated. Graphite was chosen because of its rather simple cross section and the likelihood that it will be found in large quantities in fusion reactors. The present work compares measured second, fourth, and sixth moments of the slowing down density at 1.458 eV from fission and fusion sources with values previously measured and calculated and with new calculations. The results of this work show that agreement between calculated and experimental slowing down densities is dependent on proper choice of source geometry and boundary conditions even when the radius of the graphite medium is as large as 122 cm. (auth)

**11685** (CONF-741040-P1, pp 259-269) RADIATION DAMAGE STUDIES WITH ACCELERATORS. Saltmarsh, M. J. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Radiation damage is one of the major technological problems associated with future reactor development programs. In the hostile environment of a reactor core, drastic changes can occur in the properties of materials in ways which are generally complex and poorly understood. Direct measurement of these effects is difficult. Fission reactors have limited space, and experiments are often long and costly. No fusion reactor is yet available. As a result many laboratories are using accelerators to explore the various facets of radiation damage. The work at Oak Ridge is based mainly on the CN Van de Graaff and the Oak Ridge Isochronous Cyclotron. The program includes the simulation of high fluence neutron damage using heavy ion beams, examination of the effect of 14 MeV neutron bombardment on surfaces, the injection of He into materials to be subsequently irradiated, and various analytical techniques which involve accelerator beams. The experiments are directed not only toward an understanding of the fundamental mechanisms of radiation damage, but also toward development of techniques for rapidly testing the damage resistance of different alloys. (auth)

**11686** (CONF-741040-P1, pp 270-277) USE OF HEAVY ION ACCELERATORS IN FUSION REACTOR-RELATED RADIATION-DAMAGE STUDIES. Taylor, A.; Dobson, D. A. (Argonne National Lab., IL). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

The heavy-ion accelerator has become an important tool in the study of the fundamentals of radiation damage in fission- and fusion-reactor materials. Present facilities for such studies within the Materials Science Division at Argonne National Laboratory are provided by two complementary accelerator systems. Examples of the work carried out are discussed. (auth)

**11687** (CONF-741040-P1, pp 278-286) CTR RELATED SURFACE DAMAGE STUDIES USING SMALL ACCELERATORS. Das, S. K.; Kaminsky, M. (Argonne National Lab., IL). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Small accelerators can be used to simulate some of the surface phenomena that will be encountered during the operation of controlled thermonuclear fusion reactors (CTR). A review of recent surface damage studies using low energy particle accelerators will be given. (auth)

**11688** (CONF-741040-P1, pp 298-310) SOME SURFACE EFFECTS OF (D, T) NEUTRONS ON CANDIDATE FUSION REACTOR MATERIALS. Harling, O. K.; Thomas, M. T.; Brodzinski, R.; Rancitelli, L. (Pacific Northwest Lab., Richland, WA). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Measurements of fast neutron sputtering ratios for (D, T) neutrons incident upon metal foils are reported. Upper limits for forward sputtering of $4 \times 10^{-4}$, $4 \times 10^{-4}$ and $8.3 \times 10^{-4}$ atoms/(D, T) neutron have been determined for single crystal Nb, annealed Nb and cold worked Nb respectively. Sputtering ratios for emission of radioactive daughter atoms following (D, T) neutron induced reactions, are reported for Nb, Au, Ti, Cu and V. Preliminary values of the sputtering ratio for Au are reported and these are lower than most previous results. A careful search for neutron sputtered micron sized particles yielded negative results. Some implications of radioactive atoms ejected from the walls of fusion reactors are discussed. (auth)

**11689** (CONF-750875-1) SURFACE EFFECTS IN CONTROLLED THERMONUCLEAR FUSION. Kaminsky, M. (Argonne National Lab., Ill. (USA)). Aug 1975. Contract W-31-109-Eng-38. 54p. Dep. NTIS $5.50.

From international meeting on surface science; Milwaukee, Wisconsin, USA (Aug 1975).

During the operation of large size plasma facilities and future controlled thermonuclear fusion reactors the surfaces of such major components as container walls, beam limiters, diverter walls and beam-dump walls of the injector region will be exposed to particle and photon bombardment from primary plasma radiations and from secondary radiations. Such radiations can cause, for example, physical and chemical sputtering, blistering, particle- and photon-impact induced desorption, secondary electron and x-ray emission, backscattering, nuclear reactions, photo-decomposition of surface compounds, photocatalysis, and vaporization. Such effects in turn can (a) seriously damage and erode the bombarded surface and (b) release major quantities of impurities which will contaminate the plasma. The effects of some of the major surface phenomena on the operation of plasma facilities and future fusion reactors are discussed. (auth)

**11690** (CONF-751125-89) ECCENTRIC COIL TEST FACILITY (ECTF). Burn, P. B.; Walstrom, P. L.; Anderson, W. C.; Marguerat, E. F. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 8p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The conceptual design of a facility for testing superconducting coils under some conditions peculiar to tokamak systems is given. A primary element of the proposed facility is a large 25 MJ background solenoid. Discussions of the mechanical structure, the stress distribution and the thermal stability for this coil are included. The systems for controlling the facility and diagnosing test coil behavior are also described. (auth)

**11691** (CONF-751125-93) ASSEMBLY OF THE PLT DEVICE. Marino, R. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1975. 2p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The assembly of the PLT device began in June 1974 with a preassembly of the mechanical structure at a remote site. The preassembly sequence incorporated final fabrication procedures with an initial staging operation. This successful staging/fabrication procedure proved to be an invaluable asset when the final assembly was started in August 1974. The assembly continued with the initial reassembly of the previously tested structural components at the final machine site. Construction was interrupted at several points to allow for toroidal field coil, vacuum vessel, and poloidal coil installation. Two phases of toroidal field coil power tests were included in the assembly sequence prior to, and just after the vacuum vessel insertion. (auth)

**11692** (CONF-751125-94) PLT TOROIDAL FIELD COIL POWER TESTS. Marino, R.; Citrolo, J.; Frankenberg, J. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1975. 2p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The PLT toroidal field coil power tests were initiated in October, 1974 to gain information in several areas. The most important objectives during the tests were the verification of deflections and stresses as predicted by Frankenberg and Smith. Also, the stability of the toroidal field coils against radial self-field loading was to be determined. Lastly, the predicted thermal characteristics of the coils were to be verified. (auth)

**11693** (CONF-751125-95) APPLICATION DATA FOR THE PLT STABILIZING FIELD RECTIFIER. Bronner, G.; Murray, J. G.; Oliaro, G. E. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1975. 2p. Dep. NTIS $4.00.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper describes the 12-pulse stabilizing field rectifier

used for vertical field production in the Princeton Large Torus (PLT). It is essential that the rectifier be reliable, and protect itself from all faults including induced transient overvoltages produced by switching and plasma instabilities. To this end, computer simulations were run to insure protection under various fault conditions. (auth)

**11694** (CONF-751125-96) PDX MACHINE POLOIDAL FIELD COILS. Heitzenroeder, P. J.; Dahlgren, F. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1975. 6p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper describes the PDX Poloidal Coils, their engineering designs, specifications, and fabrication methods. (auth)

**11695** (CONF-751125-97) DESIGN AND FABRICATION OF THE PDX POLOIDAL FIELD SOLENOID UTILIZING FIBERGLASS REINFORCED EPOXY. Young, K. S. C. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1975. 18p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper discusses the basic design of the Poloidal Field Solenoid Coil. It will be mainly concerned with the more unique features of the Solenoid such as the copper coil windings and the design of the epoxy-glass structural support mandrels. The center solenoid coil of the PDX machine consists of five different coil systems (OH No. 8, No. 9; NF No. 11; DF No. 7; EF Solenoid and CF No. 9). Three concentric fiberglass reinforced epoxy cylinder fabricated in-house will act as mandrels to support and to house the coils that will result as an integral unit. (auth)

**11696** (CONF-751125-98) PLT NEUTRAL INJECTION IGNITRON ACCELERATING SUPPLY. Ashcroft, D. L.; Murray, J. G.; Newman, R. A.; Peterson, F. L. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1975. 4p. Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A phase-controlled rectifier was designed for the accelerating supply on the PLT Neutral Beam injection system at PPPL. The rectifier must furnish 70 amperes at up to 50 KV for 300 milliseconds, with a duty cycle of up to 10 percent. Protection of the injectors requires the supply to withstand repeated crowbarring. The rectifying element selected to satisfy these requirements was a commercially-available ignitron, installed in a supporting frame and using firing circuits and controls designed by PPPL. (auth)

**11697** (CONF-760202-5) HEALTH PHYSICS ASPECTS OF ACTIVATION PRODUCTS FROM FUSION REACTORS. Shoup, R. L.; Poston, J. W.; Easterly, C. E.; Jacobs, D. G. (Oak Ridge National Lab., Tenn. (USA)). 1975. 14p. Dep. NTIS $4.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

A review of the activation products from fusion reactors and their attendant impacts is discussed. This includes a discussion on their production, expected inventories, and the status of metabolic data on these products. (auth)

**11698** (CONF-760202-9) OCCUPATIONAL HEALTH PHYSICS AT A FUSION REACTOR. Shank, K. E.; Easterly, C. E.; Shoup, R. L. (Oak Ridge National Lab., Tenn. (USA)). 1975. 6p. Dep. NTIS $4.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Future generation of electrical power using controlled thermonuclear reactors will involve both traditional and new concerns for health protection. A review of the problems associated with exposures to tritium and magnetic fields is presented with emphasis on the occupational worker. The radiological aspects of tritium, inventories and loss rates of tritium for fusion reactors, and protection of the occupational worker are discussed. Magnetic fields in which workers may be exposed routinely and possible biological effects are also discussed. (auth)

**11699** (COO-2493-3) ELASTIC STABILITY AND VIBRATION OF TOROIDAL MAGNETS FOR FUSION REACTORS. Final Report. Moon, F. C.; Swanson, C. (Princeton Univ., N. J. (USA). Dept. of Aerospace and Mechanical Sciences). Sep 1975. Contract AT(11-1)-2493. 83p. Dep. NTIS $5.00.

The vibration and elastic stability of a set of discrete superconducting toroidal field magnets arranged to form a "bumpy" torus is examined. The mutual destabilizing magnetic forces between magnet pairs are calculated using a numerical differential inductance technique. It is shown that the mutual attractive magnetic forces can produce elastic buckling of the entire toroidal set. The vibration modes of the set are also found as functions of the coil current. The response of the set of magnets to an earthquake type motion of the toroidal base is calculated. The calculations have been incorporated in a computer code which accompanies the report. Measurements are made of the lateral stiffness of a flexible, planar, superconducting coil between two rigid coils in series. These tests show a dramatic decrease in the natural bending frequency with subsequent elastic instability or "buckling" at a critical value of the current in the coils. These observations support a magnetoelastic analysis which shows that proposed designs, of toroidal field coils for Tokamak fusion reactors, have insufficient lateral support for mechanical stability of the magnets. (auth)

**11700** (GA-A-13666) TOROIDAL AND OHMIC HEATING POWER SUPPLIES FOR DOUBLET III. Callis, R. W.; Varga, H. J.; Wesley, J. C. (General Atomic Co., San Diego, Calif. (USA)). 22 Sep 1975. Contract E(04-3)-167. 16p. (CONF-751125-112). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The Doublet III magnet system consists of three coil power-supply systems. The toroidal field system is designed to produce a 26 kG field at the nominal plasma radius of 1.4 m. The Ohmic heating system provides the high peak voltage and power required to produce and heat the plasma. The field shaping coils shape and position the plasma for stable operation and confinement. These power supplies are described. (MOW)

**11701** (GA-A-13667) DOUBLET III POWER AND ENERGY STORAGE SYSTEM. Varga, H. J.; Callis, R. W.; Hubbard, E. L. (General Atomic Co., San Diego, Calif. (USA)). 22 Sep 1975. Contract E(04-3)-167. 16p. (CONF-751125-110). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A diagram is given of the entire Doublet III power system and two sources with interlocked breakers are illustrated. The basic energy source is a 69 kV transmission line of the San Diego Gas and Electric Company. The motor generators for the magnet coils are described. (MOW)

**11702** (GA-A-13673) ELECTRICAL INSULATION PROBLEMS RELATED TO THE DOUBLET III COILS. Franklin, L. H. (General Atomic Co., San Diego, Calif. (USA)). 1 Oct 1975. Contract E(04-3)-167. 16p. (CONF-751125-111). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The basic requirements of the magnet system for Doublet III are described. The discussion is broken into the following areas: (1) operating voltages and anticipated maximum transient voltages, (2) mechanical forces, (3) dimensional requirements, (4) coil geometry and position, (5) stored energy available, and (6) insulating requirements. (MOW)

**11703** (GA-A-13686) SELECTION OF MATERIALS AND JOINING PROCESSES FOR THE DOUBLET III TOROIDAL FIELD COIL. Jones, J. D.; Puhn, F. A. (General Atomic Co., San Diego, Calif. (USA)). 6 Oct 1975. Contract E(04-3)-167. 17p. (CONF-751125-114). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Fatigue tests were performed on candidate copper alloy materials. The tests were fully reversed push-pull loads, equal in tension and compression. The tests were made parallel with and perpendicular to the material grain at temperatures of 68 to 230°F. Fatigue testing was also performed on adhesive lap joints and on specimens simulating the riveted soft solder joints. All tests were fully reversed except for the riveted lap joint specimens which were alternated between no load and the indicated tensile load. (MOW)

**11704** (GA-A-13688) DESIGN OF DOUBLET III. Hubbard, E. L.; Gilleland, J. R.; Jensen, T. H.; Schupp, A. A.; Wesley, J. C. (General Atomic Co., San Diego, Calif. (USA)). 19 Sep 1975. Contract E(04-3)-167. 17p. (CONF-751125-113). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A cutaway drawing of Doublet III is given. The major radius is 1.43 m. The toroidal vacuum chamber has a rectangular cross section with a width of 0.9 m and a height of 3.0 m. The walls of the vacuum chamber are made of an Inconel corrugated sheet structure which is thin enough that a circumferential insulating break is not necessary. The set of field-shaping coils is located just outside the vacuum chamber. Design parameters for the system are given. (MOW)

**11705** (GA-A-13689) DOUBLET III ANTI-TORQUE STRUCTURE. Davis, L. G.; Gordon, H. S.; Puhn, F. A. (General Atomic

Co., San Diego, Calif. (USA)). 25 Sep 1975. Contract E(04-3)-167. 13p. (CONF-751125-109). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

An anti-torque structure is described that meets all the design criteria and involves a minimum of structural redundancy, utilizes ordinary manufacturing techniques, and incorporates adjustability. (MOW)

**11706** (HEDL-SA-958) STRESS EFFECTS IN ION BOMBARDMENT EXPERIMENTS. Garner, F. A.; Wire, G. L.; Gilbert, E. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract E(45-1)-2170. 20p. (CONF-751026-34). Dep. NTIS $4.50.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (1 Oct 1975).

Ion bombardment is employed to simulate the neutron damage that will occur in fusion reactor structural materials. These experiments usually involve specimens whose thickness is large compared to the ion range. The correct interpretation of such experiments requires inclusion of the impact of swelling-induced stresses, which arise from the rigidity of the non-swelling region beyond the ion range. An initial low level of swelling is accommodated by elastic compression of the voided region, giving rise to anisotropic stresses whose deviatoric components lead to plastic deformation by various irradiation creep mechanisms. Swelling generates the stresses which lead to creep, which in turn limits the magnitude of stress. The hydrostatic stress along the ion range eventually saturates at a level which reduces the swelling rate from the anticipated stress-free value. The swelling is fully anisotropic, two-thirds of the deformation having been diverted from directions normal to the ion beam. Crystalline anisotropy further modifies the relative rates of creep processes, and radiation-hardening of the lattice imposes an additional fluence dependence. Stress reversal at denuded zones leads to second-order stress effects. The use of step height measurements allows observation and measurement of these phenomena. Estimates of the stress levels and swelling rates can be made using swelling and creep coupling coefficients derived from fission reactor data. A significant reduction in swelling rate is predicted by this analysis. (auth)

**11707** (JAERI-M-6046) EVALUATION OF SHIELDING DESIGN OF SUPERCONDUCTING MAGNET. I. Seki, Y. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 23p. (In Japanese). INIS.

Shielding design of the superconducting magnet used in the fusion reactor in JAERI has been evaluated. The shield satisfies the design criteria. Future subjects in the shield design and the direction for shield optimization are also shown. (auth)

**11708** (JAERI-M-6055) METHOD FOR OBTAINING THE TRITIUM PRODUCTION RATE DISTRIBUTION WITH A LiF THERMOLUMINESCENCE DOSIMETER. Maekawa, H. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 15p. (In Japanese). INIS.

The measurement of tritium production rate distribution in a lithium blanket is an important subject in the experiments of fusion blanket. A method for measuring the tritium production rate in the lithium blanket with a LiF thermoluminescence dosimeter is presented. The preliminary experiment with FCA shows the method to be feasible. Problems in the actual measurement are also described. (auth)

**11709** (LA-6051) DIRECT EVALUATION OF TRANSIENT SURFACE TEMPERATURES AND HEAT FLUXES. Axford, R. A. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 8p. Dep. NTIS $4.50.

Evaluations of transient surface temperatures resulting from the absorption of radiation are required in laser fusion reactor systems studies. A general method for the direct evaluation of transient surface temperatures and heat fluxes on the boundaries of bounded media is developed by constructing fundamental solutions of the scalar Helmholtz equation and performing certain elementary integrations. (auth)

**11710** (LA-6173-MS) DESIGN OF THE ZT-1 TOROIDAL PINCH EXPERIMENT. Baker, D. A.; Burkhardt, L. C.; Dike, R. S.; Di Marco, J. N.; Forman, P. R.; Haberstich, A.; Karr, H. J.; Mann, L. W.; Phillips, J. A.; Schofield, A. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1975. Contract W-7405-ENG-36. 19p. Dep. NTIS $4.50.

Electrical design details are given for a toroidal Z-pinch device named ZT-1 that uses field programming to achieve a stable, reversed field pinch. The plasma is formed in a 4-mm-thick, 10.3-cm-i.d., high-alumina, segmented ceramic vacuum chamber. Voltages as high as 70 kV are routinely attained by interrupting with a fuse 800 kA in an inductive store. The current is diverted from the fuse to the primary of a single-turn transformer divided into quadrants. A total of 280 kV at 200 kA can then be applied to the plasma, which forms the secondary circuit of the transformer. This system produces dB/sub theta//dt's of up to 8 T/mu s; with modifications to the electrical system, dB/sub theta//dt's as low as 0.1 T/mu s are obtained. The B/sub z/ bias field of up to 0.25 T can be reversed at a rate of up to 0.2 T/mu s. Both B/sub theta/ and B/sub z/ magnetic field errors are minimized. The design of the fuses and magnetic core and the development of a low inductance and resistance metal-to-metal crowbar are described. (auth)

**11711** (LA-6178-MS) ORIGIN OF AXIAL CURRENT IN SCYLLAC. Sugisaki, K. (Los Alamos Scientific Lab., N. Mex. (USA)). Dec 1975. Contract W-7405-ENG-36. 4p. Dep. NTIS $4.50.

The origin of the axial current observed in Scyllac (a high beta stellarator experiment) is discussed. A shaped coil and/or helical winding produce rotational transform which links magnetic lines of force to the plasma column and the axial current is induced electromagnetically. This phenomenon is inherent in a pulsed high-beta stellarator. The rotational transform produced by the induced axial current is much smaller than that associated with the l equals 1, 0 equilibrium fields. The effect of the axial current on the equilibrium and stability of the plasma column is thus small. It is also shown that the magnetic field shear near a plasma surface is very strong. (auth)

**11712** (LA-UR-75-2157) DEPENDENCE OF RADIATION DAMAGE ANALYSIS ON NEUTRON DOSIMETRY. Goland, A. N.; Parkin, D. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-Eng-36. 13p. (CONF-750935-13). Dep. NTIS $4.50.

From 1st ASTM-Euratom symposium on reactor dosimetry; developments and standardization; Petten, Netherlands (22 Sep 1975).

The characteristics of defect production in neutron spectra can be determined by utilizing neutron cross section data (e.g. ENDF/B), detailed neutron spectral data and radiation damage models. The combination of neutron cross section and spectral data is a fundamental starting point in applying damage models. Calculations using these data and damage models show that there are significant differences in the way defects are produced in various neutron spectra. Nonelastic events dominate the recoil energy distribution in high-energy neutron sources such as those based upon fusion and deuteron-breakup reactions. Therefore, high-energy neutron cross sections must be measured or calculated to supplement existing data files. Radiation damage models can then be used to further characterize the diverse neutron spectra. (auth)

**11713** (LA-UR-75-2283) SCYLLA IV-P LINEAR THETA PINCH, A DESIGN AND CONSTRUCTION OVERLOOK. Bailey, A. G.; Machalek, M. D. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 5p. (CONF-751125-88). Dep. NTIS $3.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The Scylla IV-P theta-pinch device has been designed as a flexible, linear experiment to investigate linear theta-pinch concepts. It is a conventional theta pinch using Scyllac components to energize a 5-m coil. Six hundred 60-kV, 1.85-mu F capacitors are used to provide 2 MJ of energy storage which will give a maximum crowbarred field of 55 kG in a smooth 11.2-cm bore coil. The risetime is approximately 3 mu s. A 4.5-kJ preionization bank ringing at 0.4 MHz is incorporated. All machine operations are under computer control, using a Prime 300 computer. The computer, the control console, and the diagnostic readouts are located in a screen room immediately adjacent to the machine. The machine was laid out in a 10-capacitor module to facilitate maintenance and make maximum use of the available volume. (auth)

**11714** (LBL-4418) POWER SUPPLY FOR THE LBL 40 keV NEUTRAL BEAM SOURCE. Baker, W. R.; Fitzgerald, M. L.; Honey, V. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 6p. (CONF-751125-84). Dep. NTIS $4.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A 20 keV, 50 Amp, 10 millisec pulse $D^0$ Neutral Beam Source at the Lawrence Berkeley Laboratory that serves as the prototype for 12 similar sources now in operation on the 2XIIB Mirrow Machine at the Lawrence Livermore Laboratory has been recently upgraded to operate at 40 keV. The system of electronically regulated and controlled power supplies that drive the Source is described. (auth)

**11715** (LBL-4425) CONCEPTUAL DESIGN OF A NEUTRAL-BEAM INJECTION SYSTEM FOR THE TFTR. Ehlers, K. W.; Berkner, K. H.; Cooper, W. S.; Hooper, E. B.; Pyle, R. V.; Stearns, J. W. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 5p. (CONF-751125-86). Dep. NTIS $4.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The neutral-beam injection requirements for heating and fueling the next generation of fusion reactor experiments far exceed those of present devices; the neutral-beam systems needed to meet these requirements will be large and complex. A conceptual design of a TFTR tokamak injection system to produce 120 keV deuterium-ion beams with a total power of about 80 MW is given. (auth)

**11716** (LBL-4427) TEST FACILITY FOR THE DEVELOPMENT OF 150-keV, MULTI-MEGAWATT NEUTRAL BEAM SYSTEMS. Haughian, W.; Baker, W. R.; Biagi, L. A.; Hopkins, D. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 6p. (CONF-751125-80). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The next generation of CTR experiments, such as the Tokamak Fusion Test Reactor (TFTR), will require neutral-beam injection systems that produce multi-megawatt, 120-keV deuterium-beam pulses of 0.5-second duration. Since present injection systems are operating in the 10- to 40-keV range, an intensive development effort is in progress to meet a 150-keV requirement. The vacuum system and power supplies that make up a test facility to be used in the development of these injectors are described. (MOW)

**11717** (LBL-4429) SATURABLE REACTOR-CONTROLLED POWER SUPPLY SYSTEM FOR TCT/TFTR NEUTRAL BEAM SOURCES. Baker, W. R.; Hopkins, D. B.; Dexter, W. L.; Kuenning, R. W.; Smith, B. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 5p. (CONF-751125-85). Dep. NTIS $4.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

Each neutral beam source requires one major power supply, the acceleration supply, and four auxiliary power supplies. The power supplies are designed to permit independent interruption of current to any source and crowbarring within 20 mu sec, in the event of a source spark, while not disturbing the normal pulsing of all other adjacent sources. The sources are described. (MOW)

**11718** (LBL-4431) DESIGN CONSIDERATIONS AND DATA FOR GAS-INSULATED HIGH VOLTAGE STRUCTURES. Hopkins, D. B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nov 1975. Contract W-7405-Eng-48. 5p. (CONF-751125-83). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

This paper is intended to benefit the person faced with the occasional task of designing gas insulated high-voltage structures or spark gaps and who must decide upon the proper geometry, spacings, gas type, and pressure for reliable voltage-holding. An approach is presented along with a summary of how various factors affect voltage breakdown. The design procedures described apply to situations where the influence of nearby insulators is negligible. The accuracy of the data is estimated to be within 10 to 15 percent, a value usually attained in practice only when one follows the cautionary advice discussed in the paragraphs on materials preparation, gas properties, and conditioning. (auth)

**11719** (MATT-1133) MECHANICAL DESIGN OF A 250 KILOGAUSS SOLENOIDAL MAGNET. Bonanos, P. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Dec 1975. Contract E(11-1)-3073. 11p. (CONF-751125-108). Dep. NTIS $4.00.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The mechanical design and construction of a 5 cm bore, 23 cm long solenoidal magnet operated at 250 kilogauss is described. The magnet provides confining field for a plasma heated by a $CO_2$ laser. Radial diagnostic ports with a clear aperture of 0.41 cm allow viewing access near the magnet midplane. The on-axis field homogeneity is within 5 percent over a central length of 12 cm. The magnet sustained 500 to 1000 pulses at the highest field levels before catastrophic failure. (auth)

**11720** (MATT-1165) COUNTERSTREAMING-ION TOKAMAK NEUTRON SOURCE FOR LARGE AREA SURFACE RADIATION STUDIES. Jassby, D. L. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Nov 1975. Contract E(11-1)-3073. 35p. (CONF-750723-19). De. NTIS $4.00.

From international conference on radiation test facilities for the CTR surface and materials program; Argonne, Illinois, USA (15 Jul 1975).

A tokamak neutron source that produces a neutron flux approximately $10^{13}$ n/cm$^2$/s over a wall test-area of 30 m$^2$ is designed using near state-of-the-art tokamak and neutral-beam injection technologies. To maximize fusion reactivity, D and T plasma ions are grouped in two distinct quasi-thermal velocity distributions, oppositely displaced in velocity along the magnetic axis. Such counterstreaming distributions can be set up by tangential injection of all plasma ions by oppositely directed D and T neutral beams, by facilitating removal of completely decelerated ions, and by minimizing plasma recycling. Fusion energy is produced principally by head-on collisions between D and T ions in the counterstreaming distributions. For injection energies of 40-60 keV, and typical tokamak parameters, the fusion power density can be approximately 1 W/cm$^3$, with Q approximately 1 attainable for T/sub e/ equals 3.4 keV and electron energy confinement parameter n/sub e/tau/sub E/ approximately equal to 2 x $10^{12}$ cm$^{-3}$s. All plasma fueling is carried out by the injected beams, and when a significant fraction of the electron population is trapped, the plasma current can be maintained by the beams. (auth)

**11721** (ORNL-TM-5109) PROGRAM FOR DEVELOPMENT OF TOROIDAL SUPERCONDUCTING MAGNETS FOR FUSION RESEARCH, MAY 1975. Long, H. M.; Lubell, M. S. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 142p. Dep. NTIS $7.60.

The objective of this program is a tested magnet design which demonstrates the suitability and reliability needed to qualify toroidal superconducting magnets for fusion research devices in a time compatible with the D-T burning experiments time frame. The overall applied development program including tasks, manpower, and cost estimates are detailed here, but for the full toroidal system only the cost and time frame are outlined to show compatibility with the present program. The details of the full toroidal system fall under major device fabrication and will be included in a subsequent document. (auth)

**11722** (ORNL-TM-5233) INGRID: AN INTENSE NEUTRON GENERATOR FOR RADIATION-INDUCED DAMAGE STUDIES IN THE CTR MATERIALS PROGRAM. Saltmarsh, M. J.; Worsham, R. E. (eds.). (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. vp. Dep. NTIS $7.75.

The proposal is broken into the following chapters: (1) the need for a neutron irradiation facility, (2) characteristics of the neutron source, (3) the accelerator, (4) the lithium target source, (5) buildings, utilities, and experimental facilities, and (6) project management, schedule, and costs. (MOW)

**11723** (RL-75-117) STRESS ANALYSIS STUDIES IN OPTIMIZED "D" SHAPED TOKAMAK MAGNET DESIGNS. Diserens, N. J. (Science Research Council, Chilton (UK). Rutherford Lab.). Jul 1975. 16p. Dep. NTIS (US Sales Only) $4.50.

A suite of computer programs TOK was developed which enabled simple data input to be used for computation of magnetic fields and forces in a toroidal system of coils with either D-shaped or circular cross section. An additional requirement was that input data to the Swansea stress analysis program FINESSE could be output from the TOK fields and forces program, and that graphical output from either program should be available. A further program was required to optimise the coil shape. This used the field calculating routines from the TOK program. The starting point for these studies was the proposed 40 coil Princeton design. The stresses resulting from three different shapes of D-coil were compared. (auth)

**11724** (SAND-75-5443) $^3$He RELEASE CHARACTERISTICS OF METAL TRITIDES AND SCANDIUM-TRITIUM SOLID SOLUTIONS. Perkins, W. G.; Kass, W. J.; Beavis, L. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 15p. (CONF-750989-2). Dep. NTIS $3.50.

From international conference on radiation effects and tritium technology for fusion reactors; Gatlinburg, Tennessee, USA (30 Sep 1975).

Tritides of such metals as scandium, titanium, and erbium are useful materials for determining the effects of helium accumulation in metallic solids, for example, CTR first wall materials. Such effects include lattice strain and gross deformation, as reported elsewhere, which are related to $^3$He retention and ultimate release. Long term gas release studies have indicated that, during the early life of a metal ditritide, a large fraction of the $^3$He is retained in the solid. At more advanced ages (2 to 4 years, depending on the parent metal), the $^3$He release rate becomes comparable to the generation rate. Statistical analysis of the data indicates that the acceleration in $^3$He release rate depends on accumulated $^3$He concentration rather than strictly on age. $^3$He

outgassing results are presented for thin films of $ScT_2$, $TiT_2$, and $ErT_2$, and the critical $^3He$ concentrations are discussed in terms of a percolation model. Phase transformations which occur on tritide formation cast some doubt on the validity of extrapolating results obtained for metal tritides to predictions regarding the accumulation of helium in metals. Scandium is unique among the early transition and rare-earth metals in that the metal exhibits a very high room temperature tritium solubility (T/Sc equals 0.4) with no phase transformation. Indeed, even the lattice parameters of the hcp scandium lattice are only minimally changed by tritium solution, and we have succeeded in obtaining single crystal $ScT_{0.3}$ samples in two crystallographic orientations. Using a very sensitive technique, we have measured $^3He$ emission from both these samples, as well as from fine-grained thin film scandium-tritium solid solution samples ($ScT_{0.3-0.4}$). The fine-grained film samples release $^3He$ at 2 to 3 percent of the generation rate, while the emission rate from the single-crystal samples is approximately 0.05 percent of the generation rate, indicating a strong grain size effect. (auth)

**11725** (UCID-16978) DT FUSION NEUTRON IRRADIATION OF BNL-LASL SUPERCONDUCTOR WIRES AND LLL-BPNL ALUMINUM FOILS. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 5 Sep 1975. Contract W-7405-Eng-48. 6p. Dep. NTIS $4.00.

The experimental technique for irradiating the $Nb_3Sn$ multifilament wires and aluminium foils with $10^{18}$ neutrons/$cm^2$ is discussed. No test results are given. (MOW)

**11726** (UCID-16979) DT FUSION NEUTRON IRRADIATION OF BNL-LASL SUPERCONDUCTOR WIRES, WRDC ELECTRON MICROSCOPY, SAMPLES, BPNL MOLYBDENUM AND NICKEL FOILS, AND LLL ALUMINUM TENSILE SPECIMENS. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Sep 1975. Contract W-7405-Eng-48. 7p. Dep. NTIS $4.00.

The above samples were irradiated with $10^{18}$ neutrons/$cm^2$ from the LLL Rotating Target neutron source. Only the experimental technique is described. (MOW)

**11727** (UCID-16980) DT FUSION NEUTRON IRRADIATION OF BNL-LLL Al-1 PERCENT Cu WIRES, AND LLL SUPRACIL. MacLean, S. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 10 Sep 1975. Contract W-7405-Eng-48. 4p. Dep. NTIS $4.00.

The above samples were irradiated with $10^{18}$ neutrons/$cm^2$ from the LLL Rotating Target neutron source. Only the experimental technique is described. (MOW)

**11728** (UCRL-51921) ESTIMATED REFRACTIVE INDEX AND SOLID DENSITY OF DT, WITH APPLICATION TO HOLLOW-MICROSPHERE LASER TARGETS. Briggs, C. K.; Tsugawa, R. T.; Hendricks, C. D.; Souers, P. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 16 Sep 1975. Contract W-7405-Eng-48. 19p. Dep. NTIS $4.00.

The literature values for the 0.55-mu m refractive index N of liquid and gaseous $H_2$ and $D_2$ are combined to yield the equation $(N - 1)$ equals $[(3.15 \pm 0.12) \times 10^{-6}]$rho, where rho is the density in moles per cubic meter. This equation can be extrapolated to 300°K for use on DT in solid, liquid, and gas phases. The equation is based on a review of solid-hydrogen densities measured in bulk and also by diffraction methods. By extrapolation, the estimated densities and 0.55-mu m refractive indices for DT are given. Radiation-induced point defects could possibly cause optical absorption and a resulting increased refractive index in solid DT and $T_2$. The effect of the DT refractive index in measuring glass and cryogenic DT laser targets is also described. (auth)

**11729** (UCRL-77040) COMPUTER SIMULATION OF LASER-DRIVEN IMPLOSION OF DT-FILLED GLASS MICROBALLOONS. Larsen, J. T. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1975. Contract W-7405-Eng-48. 43p. (CONF-751130-5). Dep. NTIS $5.00.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

The results of some experimental measurements of laser implosions are analyzed. Calculations are made of specific target irradiations and compared with experiments. A general description is given of exploding pushers and the physical processes involved are described. (MOW)

**11730** (UCRL-77041) MODELS OF ELECTRON CONDUCTIVITY WHICH LEAD TO ABLATION STABILIZATION OF FLUID INSTABILITIES IN LASER-DRIVEN IMPLOSIONS. Lindl, J. D.; Mead, W. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 17 Oct 1975. Contract W-7405-Eng-48. 22p. (CONF-751130-8). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

LASNEX calculations with a modified electron conductivity show the existence of a firepolishing stabilization effect. By modifying the thermal conductivity so that K alpha T/sup n//rho/sup m/, one is able to construct a situation in which the electrons deposit their energy in a thin layer at the ablation surface and closely match the zero order solutions assumed earlier. The firepolishing effect appears to require that a significant fraction of the total pressure be due to the ablation process itself rather than the thermal pressure in the corona gas. It also requires KL approximately 1 where L is the scale height for decay of thermal perturbations generated at the ablation surface. For classical electron conductivity, because the thermal flux depends linearly on the grams/$cm^2$ necessary to stop the electrons, (1/rho) nabla rho approximately (1/T) nabla T near the ablation surface so that the pressure is nearly constant across the ablation surface. Hence there is no ablation pressure as such and no firepolishing effect for electron-driven implosions. (auth)

**11731** (UCRL-77044) ANALYSIS OF THE BALL-PLATE LASER FUSION TARGET EXPERIMENTS. Pan, Y. L. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Oct 1975. Contract W-7405-Eng-48. 18p. (CONF-751130-10). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Two dimensional computer simulation results of the two exploding pusher ball-plate targets are in approximate agreement with the experimental space and time integrated x-ray spectra, x-ray microscope data, neutron yields, and laser energy absorptions. Three parameters were used to characterize the laser absorption due to plasma instabilities. Two dumpall parameters were used to model the energy absorption and a single variable was used to define the electron temperature. The values, as well as the selection procedure for these parameters are discussed. (auth)

**11732** (UCRL-77045) FUSION TARGET DESIGNED TO MATCH PRESENT RELATIVISTIC ELECTRON BEAM MACHINE PARAMETERS. Meeker, D. J.; Nuckolls, J. H.; Bangerter, R. O. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Nov 1975. Contract W-7405-ENG-48. 24p. (CONF-751130-12). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

The range of parameters considered for this design were restricted to beam voltages of 1 MeV and pulse widths of 50 ns, with zero rise and fall time. Total beam energy was varied from 10 kJ to 100 kJ. Descriptions are given of the target and electron deposition. Computer calculations are given of electron beam heating of the fuel.

**11733** (UCRL-77150) CALCULATIONS OF SELF-GENERATED MAGNETIC FIELDS IN PARYLENE DISC EXPERIMENTS. Dahlbacka, G. H.; Mead, W. C.; Max, C. E.; Thomson, J. J. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 14 Oct 1975. Contract W-7405-Eng-48. 13p. (CONF-751130-9). Dep. NTIS $4.50.

From APS meeting; St. Petersburg, Florida, USA (10 Nov 1975).

Experiments have been planned at Livermore to measure self-generated magnetic fields using the Faraday Rotation of frequency quadrupled 1.1 mu m laser light. The LASNEX code was used during the planning of these experiments and has provided valuable information in establishing the conditions under which the thermoelectric fields expected can be measured. Suspected thermoelectric fields have been inferred from experiments that have been carried out at NRL. (auth)

**11734** (UCRL-77214) 2XIIB GETTER MATERIAL PROBLEMS. Vogtlin, G. F. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. Contract W-7405-Eng-48. 8p. (CONF-751125-78). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The uniformity of wire characteristics is vital to the reliable long-time operation of the titanium alloy wire. Of particular importance is the diameter, total emissivity, and alloy mix. The getter wire must be operated at a minimum rate while the life is determined by the maximum rate. At a particular current the difference between the maximum and minimum rate is determined by variations in wire characteristics. Small percentage variations in these characteristics can result in large variations in gettering rate. (auth)

**11735** (UCRL-77218) COMPUTER CONTROL AND MONITORING OF NEUTRAL BEAM INJECTORS ON THE 2XIIB CTR EXPERIMENT AT LLL. Pollock, G. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. Contract W-7405-Eng-48. 9p. (CONF-751125-82). Dep. NTIS $4.50.

From 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

The original manual control system for the 12 neutral beam injectors on the 2XIIB Machine is being integrated with a computer

control system. This, in turn, is a part of a multiple computer network comprised of the three computers which are involved in the operation and instrumentation of the 2XIIB experiment. The computer control system simplifies neutral beam operation and centralizes it to a single operating position. A special purpose console utilizes computer generated graphics and interactive function entry buttons to optimize the human/machine interface. Through the facilities of the computer network, a high level control function will be implemented for the use of the experimenter in a remotely located experiment diagnositcs area. In addition to controlling the injectors in normal operation, the computer system provides automatic conditioning of the injectors, bringing rebuilt units back to full energy output with minimum loss of useful life. The computer system also provides detail archive data recording. (auth)

**11736** (UCRL-77219) ELECTRONICS SYSTEM FOR THE LLL NEGATIVE ION TEST STAND. Branum, D. R.; Kamppinen, L. M. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 18 Nov 1975. Contract W-7405-Eng-48. 6p. (CONF-751125-79). Dep. NTIS $4.50.

From IEEE 6th symposium on engineering problems of fusion research; San Diego, California, USA (17 Nov 1975).

A test stand is in operation at LLL for the purpose of developing techniques and obtaining design information which will be used to develop efficient neutral beams. The knowledge gained will be used in the design of a 200 kV neutral beam test stand scheduled for operation in CY 77. (auth)

**11737** REMOVAL OF TRITIUM FROM NEUTRON-IRRADIATED LITHIUM OXIDE. Kudo, H.; Tanaka, K. (Japan Atomic Energy Research Inst., Tokai). Radiochem. Radioanal. Lett.; 23: No. 2, 57-62(20 Oct 1975).

When neutron-irradiated $Li_2O$ was heated to 600°C under vacuum, tritium was mostly removed from the target material. More than 96% of tritium was found in a cold trap cooled at −72°C. The tritiated species predominated in the trap was assumed to be tritium oxide or tritiated water, although it has not been identified yet. In 0.8-3.5% of gaseous species were observed tritiated-hydrogen ($H_2$-T) and -methane ($CH_4$-T). The results obtained here suggested it favorable to use $Li_2O$ as a tritium breeding material for a fusion reactor. (auth)

**11738** HYDROGEN ENERGY. Part A. Hydrogen Economy Miami Energy Conference, Miami Beach, Florida, March 18-20, 1974. Veziroglu, T. N. (ed.). New York; Plenum Publishing Corporation (1975). 715p. (CONF-740306−PA).

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974).

Forty-five papers presented at the THEME conference have been abstracted separately. Two items have been announced in both Nuclear Science Abstracts and ERDA Energy Research Abstracts, and forty-four have been announced in ERDA Energy Research Abstracts. (LK)

*For abstracts of individual papers see: 11739 and 11740.*

**11739** HYDROGEN: THE ULTIMATE ENERGY SOURCE. Hirschberg, J. G. (Univ. of Miami, Coral Gables, FL). pp 107-111 of Hydrogen Energy. Part A. Veziroglu, T. N. (ed.). New York; Plenum Publishing Corp. (1975).

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974). See CONF-740306-PA.

Nuclear fusion of hydrogen provides an attractive source of energy for the Hydrogen Economy. There is plenty of raw material: the oceans and lakes of the world can supply enough heavy hydrogen to satisfy our present needs for countless millenia to come. The process is clean; the only lasting product is inert helium. The exploration of possible methods to unlock this source of energy spans 30 years and as many countries. A solution of this, perhaps the central technological problem of our time, remains elusive, although we are apparently approaching it. (auth)

**11740** TECHNOLOGY AND ECONOMICS OF HYDROGEN PRODUCTION FROM FUSION REACTORS. Powell, J.; Salzano, F. J.; Sevian, W. A. (Brookhaven National Lab., Upton, NY). pp 255-277 of Hydrogen Energy. Part A. Veziroglu, T. N. (ed.). New York; Plenum Publishing Corp. (1975).

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974). See CONF-740306-PA.

The technology, economics, and environmental effects of producing synthetic fuels ($H_2$ gas, $H_2$ liquid, and methanol) based on fusion (CTR) reactors are assessed. Four United States energy systems (2020 A.D.) with different degrees of CTR implementation are compared: in System A, no CTR input is assumed; in System B, CTRs replace 50 percent of nuclear fission electric; in System C, CTRs supply all electrical demand, produce synthetic fuels to replace all oil and gas imports, and eliminate strip mining; and in System D, CTRs supply all electrical demand and virtually all fuel demand. CTR reactor costs are analyzed in detail for a range of containment parameters, reactor outputs, and first well loadings for DT and catalyzed DD fuel cycles. (auth)

**11741** REFLECTIVE OPTICS SYSTEM FOR UNIFORM SPHERICAL ILLUMINATION. Phipps, C. R. Jr.; Bodner, S. E.; Shearer, J. W. (Univ. of California, Livermore). Appl. Opt.; 14: No. 4, 985-991(Apr 1975).

A reflective optical system is described that permits nearly uniform illumination of a small sphere with one or two laser beams. The primary application of this device is to studies of laser-driven implosion of small targets. Other applications include the production of plasma by optical breakdown of gases for spectroscopic studies and for optimum light collection in intensity-limited plasma diagnostics. Simple calculations show that the intensity mapping properties of this system are not excessively sensitive to variations in the radial intensity distribution nor to departures from diffraction-limited propagation in the input beams. Optical damage and the illuminated solid angle required at the focus determine the size of the device. (auth)

**11742** RESULTS FROM THE TOKAMAK FONTENAY-AUX-ROSES. Ginot, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Bull. Inf. Sci. Tech. (Paris); No. 202, 55-64 (Apr 1975). (In French)

It became clear in 1969 that confinement and heating in Tokamaks offered great possibilities and the Fontenay-aux-Roses Tokamak (TFR) was built for research on their improved efficiency. A plasma of mean density $4.5 \times 10^{13}$ $cm^{-3}$ and of maximum electron and ion temperatures 2.5 and 1 keV respectively was obtained. The current induced in the gas reached 0.4 MA and discharges were maintained for more than 0.5s. The ion assembly seems to behave according to the mechanism predicted by theory, that of electrons suffers an abnormal energy loss. These results confirm and add to those obtained earlier. The machine is now being used for the detailed study of an energy balance and of the most plausible loss mechanisms (turbulence, impurities) and for the development of new heating methods. (FR)

**11743** TOKAMAK DEVICES: TOWARDS CONTROLLED FUSION. Trocheris, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Bull. Inf. Sci. Tech. (Paris); No. 202, 5-6(Apr 1975). (In French)

The Tokamak family is from the Soviet Union. These devices were exclusively studied at the Kurchatov Institute in Moscow for more than ten years. The first Tokamak started in 1970 at Princeton. The TFR (Tokamak Fontenay-aux-Roses) was built to be superior to the Russian T4. Tokamak's future is now represented by the JET (Joint European Tokamak). (FR)

**11744** TOKAMAK FONTENAY-AUX-ROSES (T.F.R.). Torossian, A. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Bull. Inf. Sci. Tech. (Paris); No. 202, 17-30(Apr 1975). (In French)

The Tokamak TFR is a plasma research machine which by its performance marks an important stage towards controlled fusion. Its nominal specifications are, tore large radius R = 98cm, plasma radius a = 20cm, maximum plasma current $I_p$ = 400kA, maximum magnetic field on the axis $B_T$ = 60kG. The general layout of Tokamaks, the essential technological characteristics of the machine, and the various sources of energy needed for its operation are described. (FR)

**11745** WEGA STELLARATOR. Consoli, T. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). Bull. Inf. Sci. Tech. (Paris); No. 202, 93-100(Apr 1975). (In French)

The machine Wega, under construction at the CEN Grenoble, is a stellarator of dimensions equivalent to those of Petula and intended in the same way for research on different methods of plasma heating by high-frequency fields. This machine can also work as a Tokomak. The first heating method considered here lies in a frequency range close to 500MHz (at the lower hybrid resonance) with an anticipated maximum peak total power of 400kW. (FR)

**11746** CONTROLLED THERMONUCLEAR FUSION. Why Tokamaks. Aymar, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Bull. Inf. Sci. Tech. (Paris); No. 202, 7-15(Apr 1975). (In French)

A brief history of the development of research on plasma confinement introduces the various possible lines of approach towards the thermonuclear reactor, with special reference to the most

promising direction, that of tokamaks. The different physical concepts used in magnetic confinement are then reviewed, with emphasis on the tokamak configuration. (FR)

**11747** FUTURE OF TOKAMAK DEVICES: PROSPECTS AND REALITIES. Aymar, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). Bull. Inf. Sci. Tech. (Paris); No. 202, 83-91(Apr 1975). (In French)

The new and promising situation with regard to thermonuclear fusion research is described. Experimental results obtained on tokamaks suggest that ignition conditions may be attained within the next ten years and that fusion will thus be proved scientifically feasible. The strategy of the various programmes foreseen is analyzed in this context. Projected large machines are mentioned with special reference to the J.E.T. The preparation of the next stage is outlined in relation to reactor model studies, thus announcing a transition during which physical problems largely give way to technological considerations. (FR)

**11748** LE TOKAMAK PETULA. Consoli, T. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service d'Ionique Generale). Bull. Inf. Sci. Tech. (Paris); No. 202, 65-81(Apr 1975). (In French)

The machine Petula, built at the CEN Grenoble, is a Tokamak of geometric dimensions and minimum physical specifications chosen to allow the study of different processes of plasma heating by oscillating fields. Some fundamental theoretical aspects of one of these heating methods, known as transit time magnetic pumping (TTMP), is dealt with. The machine itself is then described, with special attention to the influence of this plasma heating process on the design of the machine. (FR)

**11749** METHOD FOR THE CONTROLLED LIBERATION OF FUSION NUCLEAR ENERGY. (to KMS Industries, Inc.). French Patent 2,196,505/A/. 18 Aug 1972. 22p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention concerns thermonuclear reactions. It refers to a fusion procedure in which the laser energy is concentrated on miniscule fuel spheres of deuterium and tritium so as to create both a surface plasma assuring efficient energy transfer and shock waves converging at the center and assuring nuclear fusion of the central matter. It is applicable to the production of thermal energy by nuclear fusion. (tr-FR)

**11750** INTRODUCTION AND SUMMARY. Rose, D. J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering); Carruthers, R. (UKAEA Research Group, Abingdon. Culham Lab.). pp 3-14 of Fusion Reactor Design Problems. Proceedings of an IAEA Workshop Held at Culham, UK, 29 January–15 February 1974. Vienna; IAEA (1974).

From IAEA workshop on fusion reactor design problems; Culham, Berkshire, UK (29 Jan 1974). (International Atomic Energy Agency, Vienna (Austria)).

A workshop was held at the UKAEA Culham Laboratory from 29 January to 15 February 1974, attended by 52 representatives from ten nations, plus Euratom and the IAEA. All phases of work related to eventual fusion reactors (as distinct from plasma physics) were discussed in terms of both fusion concepts (Tokamaks, laser fusion, etc.) and general technological problems (materials, tritium recovery, etc.). Eight specific workshop studies were made as follows: plasma impurities and burning time; reactor start-up; vacuum wall protection; tritium; materials; repair and accessibility; fission-fusion; environmental effects. This paper gives summaries of the workshop activities and of the eight specific studies, plus a concluding commentary. (auth)

## Wave Phenomena

*Refer also to abstracts 11622 and 11669.*

**11751** (CEA-N-1810) CHANGE IN THE CUT FREQUENCY IN A HOMOGENEOUS PLASMA DUE TO RELATIVISTIC EFFECTS. Bourdier, A.; Di Bona, G.; Guillaneux, P. (CEA Centre d'Etudes de Limeil, 94-Villeneuve-Saint-Georges (France)). 7 May 1975. 19p. (In French). INIS.

The study of the interaction of a strong electromagnetic wave with a plasma sets the problems of the validity of the dipolar approximation and of the wave propagation below the frequency of the conventional cut. The problems are treated for the case of a cold, homogeneous electron-ion plasma interacting with rectilinearly polarized electromagnetic wave, using the Maxwell-Lorentz equation system. The dipolar approximation is shown to have a physical significance in a relativistic theory. When the space dependence of the electric field is taken in account, neglecting the wave magnetic field influence is not consistent. The cut frequency and dispersion relation modified by relativistic effects are written. (FR)

**11752** (CONF-740642-, pp A1.1-A1.9) EIGENMODE STRUCTURE IN BOUNDED INHOMOGENEOUS PLASMA SLAB NEAR ION CYCLOTRON FREQUENCY. Adam, J.; Takahashi, H. (Princeton Univ., NJ). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The wave field distribution in a parallel-plate waveguide filled with plasma has been investigated near the ion cyclotron frequency by numerical integration of the full cold plasma equations taking electron inertia into account. The static magnetic field is parallel to the waveguide axis and its intensity varies across the waveguide cross-section. The density profile is taken to be parabolic. Contrary to the predictions of the theory neglecting electron inertia, discrete eigenmodes are found regardless of the presence of the so-called "perpendicular resonance layer" within the plasma. In contrast to homogeneous plasmas, the short-wavelength electrostatic branch of the slow wave solutions is important in inhomogeneous plasmas and the eigenmode structure of the two cases are considerably different from each other. (auth)

**11753** (CONF-740642-, pp B2.1-B2.6) NUMERICAL SOLUTION FOR LINEAR WAVE CONVERSION NEAR LOWER HYBRID RESONANCE. Simonutti, M. D.; Parker, R. R. (Massachusetts Inst. of Tech., Cambridge). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Linear mode conversion near lower hybrid resonance in an inhomogeneous plasma is studied in the theory of the moment equations with finite T/sub e/ and T/sub i/, without collisions, and in the electrostatic approximation. A first order linear system based on a self-consistent zero order solution to these equations is derived along with a complex small signal conservation theorem. A numerical solution is obtained yielding, along with the well known result of complete mode conversion, the spatial dependence of each variable in the conversion region. A spectrum of these single k/sub z/ wave solutions is synthesized to form the resonance cone response. (auth)

**11754** (CONF-740642-, pp B8.1-B8.6) COLLISIONAL EFFECTS ON ANTI-RESONANT MODE CONVERSION IN AN INHOMOGENEOUS MAGNETOPLASMA. Tang, T.; Wong, K. C. (Univ. of Massachusetts, Amherst). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

The effects of small collisional damping on the mode conversion of an extraordinary wave incident upon a warm magnetoplasma slab are studied. When a converted Bernstein mode is at anti-resonance, the absorption coefficient can be as high as 0.5 at very low collision frequencies. (auth)

**11755** (CONF-740642-, pp C2.1-C2.6) EXPERIMENTAL INVESTIGATIONS OF A HELICAL ANTENNA FOR EXCITING ALFVEN WAVES. Knox, S. O.; Paoloni, F. J.; Kristiansen, M.; Hagler, M. O. (Texas Tech Univ., Lubbock). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

A new coupler for exciting Alfven waves was experimentally investigated. The coupler, which consists of four symmetric helical straps wound around the vacuum vessel, is driven by a four-phase rf source. It has been determined that this coupler excites waves that vary azimuthally as e/sup jm theta/, where m equals +-1. The coupler exhibits a strong propagation directionality and is capable of launching waves whose wavelength differs considerably from its own. (auth)

**11756** (CONF-740642-, pp E7.1-E7.7) INTERACTION OF ELECTROMAGNETIC WAVES WITH MAGNETIZED PLASMA. Ferrari, L. A.; LaHaye, R. J.; McQuade, A. W. (Univ. of New York, Flushing). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

Linearly polarized electromagnetic waves, with power densities up to 12 watts/cm$^2$ (f equals 2.45 GHZ) are propagated in a cylin-

drical waveguide which is located in an external magnetic field. Plasma, with density N/sub e/ approximately 2 x $10^{11}$ $cm^{-3}$ and T/sub e/ equals 8-10 eV and 30 cm axial length, is produced by electron cyclotron resonance. At this density the left component of the incident wave is nominally cut off. For a suitable choice of experimental parameters one finds that approximately 25 percent of the power in the left wave is transmitted through the plasma. The transmission occurs for a period of time 0 less than t less than tau following application of the RF. Transmission ceases suddenly at t equals tau and the plasma for t greater than tau is opaque. Dynamic measurements of the plasma density profile and distribution of EM fields within the plasma during the transmission period are presented. (auth)

**11757** (JAERI-M-5934) DECAY OF POLOIDAL ROTATION IN A TOKAMAK PLASMA. Tuda, T. (Japan Atomic Energy Research Inst., Tokyo). Dec 1974. 15p. (In Japanese). INIS.

The decay of poloidal rotation in a tokamak plasma has been studied for the banana regime. A very fast damping mechanism of the order $\delta^{\frac{1}{2}}/\nu_{ii}q^2$ ($\delta$ is the inverse aspect ratio, $\nu_{ii}$ the ion collision frequency, q the safety factor) is shown to exist. The plasma in a tokamak has a large effective dielectric constant by a factor $(B_T/B\theta)^2$. (auth)

**11758** (LRP-98/75) ASYMPTOTIC FORM OF GREEN'S FUNCTION FOR WAVE EMISSION IN PLASMAS. Weibel, E. S. (Ecole Polytechnique Federale, Lausanne (Switzerland)). Nov 1975. 17p. Dep. NTIS (US Sales Only) $4.50.

Green's function for the emission of radiation from an oscillating point source within a plasma is examined in the limit of large distances from the source. The plasma is characterized by its susceptibility tensor X leading to the dispersion relation $D(\omega,k) = 0$. Asymptotic formulas are derived which state that only those points in k-space contribute to the far field which satisfy the dispersion relation and for which the group velocity points towards the observer. The intensity of the emission is inversely proportional to the Gaussian curvature of the surface $D(\omega,k) = 0$ at that point. The result is generalized for the case in which this curvature vanishes. (auth)

**11759** INCOHERENT WAVE SCATTERING AT THE UPPER HYBRID FREQUENCY. Mendonca, J. T.; Zanfagna, B. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaire de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). J. Phys. (Paris), Lett.; 36: No. 6, L.165-L.167 (Jun 1975). (In French)

Enhanced incoherent scattering at the upper hybrid layer of an extraordinary electromagnetic wave propagating in an inhomogeneous magnetized plasma has been observed. (FR)

**11760** EFFECT OF DENSITY GRADIENT AND CURVATURE ON THE REFLEXION OF ELECTROSTATIC WAVES IN INHOMOGENEOUS PLASMA. Doucet, H. J. (Ecole Polytechnique, 91—Palaiseau (France)); Feix, M. (Centre National de la Recherche Scientifique, 45 - Orleans-la-Source (France). Groupe de Recherches Ionospheriques). J. Phys. (Paris); 36: No. 6, 517-521(Jun 1975). (In French)

Plasma wave reflection is shown to be related to the density gradient while ion acoustic wave reflection is related to positive curvature. This explaines why one has failed to observe ion acoustic wave reflection in typical experimental devices. (FR)

**11761** THREE-WAVE INTERACTIONS IN MAGNETIZED PLASMAS. Larsson, J.; Stenflo, L. (Umeaa Univ. (Sweden). Plasmafysiska Institutionen). Beitr. Plasmaphys.; 13: No. 3, 169-181(1973).

This paper considers the nonlinear interaction between three waves in a warm magnetized plasma (two-component). A general formalism is developed within a simple macroscopic theory in order to treat waves propagating in arbitrary directions. Some results of previous papers are generalized and discussed. (auth)

**11762** LONGITUDINAL WAVES IN A RELAXING PLASMA. Bhatnagar, T. N.; Sharma, S. R. (Rajasthan Univ., Jaipur (India). Dept. of Physics). Phys. Lett., A; 54: No. 1, 99-100 (11 Aug 1975).

The effect of collisions on longitudinal waves in a plasma with an anisotropic pressure has been considered and the time evolution of the amplitude and the phase of the wave are calculated. (auth)

**11763** PLASMA MICROWAVE ABSORPTION IN NONRESONANCE MAGNETIC FIELDS. Nanobashvili, S. I.; Rostomashvili, G. I.; Tsintsadze, N. L. (Inst. of Physics, Tbilisi, USSR). Sov. Phys.—Tech. Phys. (Engl. Transl.); 20: No. 2, 280-281 (1975).

Translated from Zh. Tekh. Fiz.; 45: No. 2, 445-447(Feb 1975).

Microwave absorption by a plasma in a magnetic field is studied. The plasma is produced by microwave power at the electron gyroresonance frequency. Microwave absorption in the plasma is observed in magnetic fields above the gyroresonance field, presumably due to nonlinear effects. (auth)

**11764** EFFECT OF COLLISIONAL PLASMA ON THE TRANSIENT RESPONSE OF ELECTROMAGNETIC PULSES. Pandey, N. L.; Singh, R. N. (Banaras Hindu Univ., Varanasi, India). Indian J. Phys.; 49: No. 4, 312-317(Apr 1975).

The transient response of short duration electromagnetic pulses reflected from collisional plasma was studied. With the help of expressions obtained for the real and imaginary parts of reflected electromagnetic field vectors, the polarization characteristics were studied. It is shown that the change in the polarization characteristics is of significant diagnostic value. (auth)

**11765** IDENTIFICATION AND SATURATION OF THE ISOTHERMAL PARAMETRIC ION ACOUSTIC DECAY INSTABILITY. Flick, J. T. Princeton, NJ; Princeton Univ. (1974). 99p. University Microfilms Order No. 75-23,199.

Thesis (Ph. D.).

This work is an experimental and theoretical analysis of the isothermal ion acoustic decay instability, excited by an intense RF field near the electron plasma frequency. Identification of this instability, where acoustic waves are severely ion Landau damped, is achieved primarily by measurements of wavelength and frequency, and its threshold and acoustic frequency dependence upon density. Properties of the unstable steady-state are also studied, showing that saturation, ($E^2$/sub inst/) alpha $E_0^2$, occurs without significant changes in instability spectra and wavelengths (no cascading). A theoretical saturation model that includes the effect of parametric action of large-amplitude decay waves back on the pump (in addition to the linear parametric instability equations) is presented. The predictions of this model are shown to be in agreement with observations of the saturated state. (Diss. Abstr. Int., B)

**11766** CLASSICAL INDUCED SCATTERING OF COHERENT WAVES. Johnston, R. S. Princeton, NJ; Princeton Univ., (1974). 252p. University Microfilms Order No. 75-23,213.

Thesis (Ph. D.).

Contributions are made to the classical theory of induced scattering in plasma. The presentation is in two parts. Particle trapping in the beat potential produced by the mixing of two coherent waves lies outside the domain of the conventional weak-turbulence theory of induced scattering. In part one, a canonical reformulation of the theory is presented which is applicable to this extended domain. A review of the literature on the subject of induced scattering is presented at the outset. Both the quantum mechanical regime and the classical limit are considered, with an extensive and current bibliography. Then the motivation for an extension of the conventional theory is discussed, with reference to specific laboratory and astrophysical applications. The reformulation presented is based upon a canonical transformation to oscillation-center variables. The potential value of such dressed-particle transformations is assessed in the more general context of plasma kinetic theory, and speculations are made concerning a reformulation of strong-turbulence theory. In part two, plasma effects are suppressed and attention is focussed on the resonant interaction between a single relativistic charge and two coherent electromagnetic waves. The simplification in context is exploited to elucidate several aspects of the nonlinear theory of induced scattering. (Diss. Abstr. Int., B)

**11767** THEORY OF TRANSFER OF WAVES IN DISPERSIVE MEDIA WITH APPLICATIONS TO LANGMUIR AND RADIO WAVES IN PLASMAS. McMullin, J. N. Rochester, NY; Univ. of Rochester (1975). 307p. University microfilms Order No. 75-22,757.

Thesis (Ph. D.).

A general theory of wave transfer in dispersive medium is presented which is applicable when the wave lengths are much smaller than the scale lengths of the macroscopic parameters. It is assumed that collective oscillations can be quantized and an equation of transfer is derived for the occupation number N(k vector,x vector,t), of quanta in the state of momentum Dirac constant k vector and energy Dirac constant omega(k vector,x vector). Expressions are derived relating N(k vector,x vector,t) to the specific intensity of energy, I/sub omega/, and relating the quantum mechanical annihilation rates to the classical damping coefficients. The linear atmosphere approximations are used to study the effects of l-wave propagation in the time-dependent Type III radio burst problem. It is shown that for frequencies less than 10 MHz, the time in which l-waves are absorbed by Landau damping is shorter than the collisional damping time in the solor corona. A modified form of the one-dimensional quasi-linear equations is derived taking into account a finite electron

density scale height. It is shown that the effects of refraction on the burst profile may be handled in a general way and that the linear atmosphere approximations may be applied to the radio waves at the fundamental frequency of generation. (Diss. Abstr. Int., B)

**11768** FIZIKA PLAZMY. (Plasma Physics). Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). 196p.

Separate abstracts were written for 9 included papers.

*For abstracts of individual papers see: 11663 and 11769–11776.*

**11769** OSCILLATIONS OF PLASMA PLACED IN A STRONG ALTERNATING ELECTRIC FIELD. Tsintsadze, N. L.; Tskhakaya, D. D.; Khirseli, E. M. pp 5–44 of Fizika Plazmy. Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). (In Russian)

The influence of relativistic effects on natural plasma oscillations is studied. It is shown, that relativistic change of electron mass considerably changes the dispersion properties of plasma. In particular, oscillation of the mass of electrons may lead to parametric buildup of both potential and nonpotential oscillations. When a system plasma (relativistic electron beam) interacts with external hf radiation a stabilization of a beam instability takes place. In the case of a resonance, when the overtone of the external frequency is close to the electron Langmuir frequency, new instabilities are formed which without an external field do not occur. (auth)

**11770** INVESTIGATION OF LOW FREQUENCY ELECTRICAL FIELD INTERACTION WITH THE IONIC SOUND OSCILLATIONS IN BOUND WEAKLY IONIZED PLASMA. Barkhudarov, E. M.; Kervalishvili, N. A.; Kortkhondzhiya, V. P.; Tsintsadze, N. L.; Tskhakaya, D. D. pp 45–82 of Fizika Plazmy. Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). (In Russian)

The possibility of parametric amplification and attenuation of the ionic sound waves as a result of the modulation of the charged particle density is shown experimentally. It was found that under certain conditions the interaction has the nonlinear character. In the kinetic approximation in the framework of the linear theory the increment and the resonance half width are calculated in the case when the external field frequency is that of the double frequency of the proper oscillations. The possibility of explaining the attenuation of the ionic sound waves as a result of the nonlinear interaction of the proper modes is considered. (auth)

**11771** THEORY OF PARAMETRIC EXCITATION OF LANGMUIR OSCILLATIONS IN RELATIVISTIC ELECTRON PLASMA. Tsikarishvili, E. G.; Tsintsadze, N. L. pp 83–88 of Fizika Plazmy. Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). (In Russian)

Parametric excitation of Langmuir oscillations, caused by electron mass in the external alternating field, is considered in relativistic plasma. Increments for Langmuir oscillations are obtained. (auth)

**11772** MODULATED WAVES PROPAGATING IN THE COLLISIONLESS MULTICOMPONENT PLASMA. Pataraya, A. D.; Rostomashvili, Z. I. pp 95–113 of Fizika Plazmy. Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). (In Russian)

The paper is devoted to the modulated steady and unsteady nonlinear waves in the multicomponent collisionless plasma in the external magnetic field. Two types of the nonlinear waves were investigated. First the unsteady modulated Bernstein's mode in hot multicomponent plasma is considered. The solution of this task is carried out with the aid of the perturbation theory. The kinetic equations for the charged particles are used. The differential equation for the amplitude of this wave was obtained. The problem of Bernstein nonlinear wave stability is investigated. The paper considers the steady modulated nonlinear wave propagating along the magnetic field in the three-component cold quasi-neutral plasma. The plasma consists of electrons, the positively charged and negatively charged ions. The relative motion of the charged particles takes place in the range before the wave in the wave system. The relation between Mach number and the maximum value of the magnetic field strength was obtained. (auth)

**11773** COLLISIONLESS SHOCK WAVE STRUCTURE STIPULATED BY BERNSTEIN'S MODES. Kaladze, T. D.; Lominadze, D. G.; Pataraya, A. D. pp 114–120 of Fizika Plazmy. Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). (In Russian)

The structure of the collisionless shock wave propagating across the external magnetic field stipulated by the Bernstein's modes is studied. It is shown that with account for the effective frequency of the collision in the magnetohydrodynamics the existence of the solitary wave propagating across the magnetic field even under the condition of $T_i \geq T_e$ ($T_i$, $T_e$–are the temperatures of plasma ions and electrons) is found. (auth)

**11774** PROBLEM OF THE OSCILLATION EXCITATION INSIDE THE SOLITARY WAVE. Loladze, Ts. D. pp 121–124 of Fizika Plazmy. Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). (In Russian)

The structure of the ordered electrostatic oscillations inside the solitary wave propagating in the external magnetic field and the instability of the nonlinear wave at small Mach numbers were studied. (auth)

**11775** MANDELSTAMM–BRILLOUIN FORCED SCATTERING AT LANGMUIR OSCILLATIONS. Suramilishvili, G. I. pp 125–130 of Fizika Plazmy. Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). (In Russian)

A problem on the Mandelstamm–Brillouin forced scattering in presence of the scattering medium of the Langmuir oscillations is considered. The amplification coefficient of the scattered stokes wave is found. It is shown that the availability of Langmuir turbulent pulses changes the line width of the scattered emission, the maximum of the amplification coefficient and leads to the frequency shift of this coefficient. (auth)

**11776** NONLINEAR SCATTERING OF HIGH FREQUENCY WAVES ON THE ELECTRON IN THE MAGNETOACTIVE PLASMA. Tavdgiridze, T. L. pp 131–139 of Fizika Plazmy. Loladze, Ts. D.; Lominadze, D. G. Tbilisi, USSR; Izdatel'stvo Metsniereba (1975). (In Russian)

The passage of the fast charged particles through the weakly turbulent plasma in the constant magnetic field is considered. The expressions for the energy losses corresponding to the processes of the plasma wave scattering on the plasma charged particles, namely the processes of Compton and nonlinear scattering were obtained. It is shown that the nonlinear scattering exceeds the Compton scattering and in addition in some cases the acceleration of the electron by the high frequency waves of the weakly turbulent plasma is possible. (auth)

# ENGINEERING

**11777** (CONF-750827--, pp 367-382) DESIGN FEATURES FOR DECONTAMINATION IN NEW PLUTONIUM FACILITIES. Freiberg, K. J.; Haynes, C. G. (Rockwell International, Golden, CO). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

Specific features for preventing, containing, controlling, and removing contamination in the Plutonium Recovery and Waste Treatment Facility are outlined. (LK)

**11778** (LBL-3868) SLIDING RESPONSE OF RIGID BODIES TO EARTHQUAKE MOTIONS. Aslam, M.; Godden, W. G.; Scalise, D. T. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1975. Contract W-7405-eng-48. vp. Dep. NTIS $7.60.

A fundamental study of the sliding response of massive concrete blocks to earthquake ground motions, including the effect of vertical accelerations/decelerations on the friction forces, is reported. This particular problem occurs when large concrete blocks are used as radiation shields in nuclear particle accelerator installations in seismic areas. The results of this study can also help in understanding the response of other rigid bodies (as approximated by some electrical/mechanical equipment) which are not anchored to the ground. Based upon the simple theory of friction and equations of motion, a computer program BLOKSLD was written to predict the sliding motion of a rigid block under the effect of simultaneous horizontal and vertical earthquake accelerations. The accuracy of computer-predicted results was checked against the experimental data and a satisfactory agreement (10 percent) was found. Tests were conducted with concrete blocks on a newly constructed 20 x 20 ft shaking table which can reproduce independent horizontal and vertical displacement components. Tests were made for both sinusoidal and actual earthquake ground motions. Various materials were tried between the concrete block and the shaking table to reduce the coefficient of friction and to study the suitability of such materials for this purpose. Input table accelerations and the relative displacements between table and block were recorded for comparison with computer results. (auth)

## Energy Conversion

*Refer also to abstracts 12186 and 13964.*

## Facilities and Equipment

*Refer also to abstracts 11559–11561, 11563, 11564, 11592, 11593, 12677, 12686, 12733, and 13970.*

**11779** (CONF-750827--, pp 165-206) DISPOSITION OF TA-33-21, A PLUTONIUM CONTAMINATED EXPERIMENTAL FACILITY. Cox, E. J.; Garde, R.; Valentine, A. M. (Los Alamos Scientific Lab., NM). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

This report discusses the decontamination, demolition and disposal of a plutonium contaminated experimental physics facility which housed physics experiments with plutonium from 1951 until 1960. The results of preliminary decontamination efforts in 1960 are reported along with health physics, waste management, and environmental aspects of final disposition work accomplished during 1974 and 1975. (auth)

**11780** (CONF-750827--, pp 207-221) SEPARATIONS CANYON DECONTAMINATION FACILITIES. Hershey, J. H. (E. I. du Pont de Nemours and Co., Aiken, SC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

Highly radioactive process equipment is decontaminated at the Savannah River Plant in specially equipped areas of the separations canyon building so that direct mechanical repairs or alterations can be made. Using these facilities it is possible to decontaminate and repair equipment such as 10- x 11-ft storage tanks, 8- x 8-ft batch evaporator pots and columns, 40-in. Bird centrifuges, canyon pumps and agitators, and various canyon piping systems or "jumpers." For example, centrifuge or evaporator pots can be decontaminated and rebuilt for about 60 percent of the 1974 replacement cost. The combined facilities can decontaminate and repair 6 to 10 pieces of major equipment per year. Decontamination time varies with type of equipment and radioactivity levels encountered. (auth)

**11781** (CONF-750827--, pp 303-324) DEMOLITION OF BUILDING 12, AN OLD PLUTONIUM FILTER FACILITY. Christensen, E. L.; Garde, R.; Valentine, A. M. (Los Alamos Scientific Lab., NM). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

This report discusses the decommissioning and disposal of a plutonium-contaminated air filter facility that provided ventilation for the main plutonium processing plant at Los Alamos from 1945 until 1973. The health physics, waste management, and environmental aspects of the demolition are also discussed. (auth)

**11782** (CONF-750827--, pp 345-365) PNL STUDIES OF D AND D AT HANFORD. Harmon, K. M. (Battelle Pacific Northwest Labs., Richland, WA). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

In summary, the PNL D and D at-Hanford program involves (1) the preparation of a long-term plan for a systematic approach to the extensive and varied problems of decommissioning retired facilities at Hanford; and (2) a D and D demonstration project, the decommissioning of a grossly contaminated plutonium processing facility. (auth)

**11783** (CONF-750827--, pp 403-416) HOT FUEL EXAMINATION FACILITY/SOUTH REFURBISHMENT PROGRAM. Larsen, L.; Miles, C. C. (Argonne National Lab., IL). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The Hot Fuel Examination Facility/South has been in continuous service since 1964. With the exception of a two-month air cell shutdown in 1969, all maintenance and repair has been done either remotely or by the removal of components from the cells for repair or replacement. The point has now been reached where extensive overhaul is required, and a major shutdown of the facility is planned. During the facility shutdown, the in-cell equipment will be removed from the cells. The cells will be decontaminated, cell windows and lighting will be modified, and remote-handling equipment will be improved. When the cells and cell equipment have been cleaned and modified, the facility will be returned to service in support of the LMFBR program. (auth)

**11784** (ERDA-tr-88) INVESTIGATION OF THERMAL STRESSES. Prigorovskii, N. I. (ed.). 1972. Translated from Russian Report. 322p. Dep. NTIS $9.75.

The collection gives the results of developing and employing new methods of determining thermal stresses in parts of machines and structures. Methods of modeling thermal stresses according to a given thermal field and extensometric methods and means of full-scale investigations during steady and variable thermal regimes are examined. The cited results may be used by scientific associates and specialists working in the field of rigid-body mechanics, and in investigating and calculating stresses in the parts of machines and structures. (auth)

**11785** (PERC-0055-1) BUBBLE BEHAVIOR ON THE SCALE-UP OF FLUIDIZED BED HEAT EXCHANGERS. Quarterly Technical Progress Letter, 1 September 1975–30 November 1975. (Idaho Univ., Moscow (USA)). 1975. Contract E(36-3)-0055. 4p. Dep. NTIS $3.50.

Progress during Sept. to Dec. 1975 in research on fluidized bed heat exchangers is reported. Heat transfer measurements were completed for a vertical tube immersed in 230 mu spherical glass beads with results similar to those obtained in the thin beds. Results using heat transfer models for thin beds with 230 mu and 470 mu glass spheres are compared with experimental data. Only the single particle conduction model of Botterrill gives consistent results for both size particles. (LCL)

**11786** (UCRL-13668) DEVELOPMENT OF A DESIGN BASIS TORNADO AND STRUCTURAL DESIGN CRITERIA FOR THE NEVADA TEST SITE, NEVADA. Final Report. McDonald, J. R.; Minor, J. E.; Mehta, K. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Jun 1975. 64p. Dep. NTIS $4.50.

In order to evaluate the ability of critical facilities at the Nevada Test Site to withstand the possible damaging effects of extreme winds and tornadoes, parameters for the effects of tornadoes and extreme winds and structural design criteria for the design and evaluation of structures were developed. The meteorological investigations conducted are summarized, and techniques used for developing the combined tornado and extreme wind risk model are discussed. The guidelines for structural design include methods for calculating pressure distributions on walls and roofs of structures and methods for accommodating impact loads from wind-driven missiles. Calculations for determining the design loads for an example structure are included. (LCL)

**11787** (UCRL-51928) EVALUATION OF METHODS FOR SEISMIC ANALYSIS OF MIXED-OXIDE FUEL FABRICATION PLANTS. Tokarz, F. J.; Arthur, D. F.; Murray, R. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1975. Contract W-7405-Eng-48. 64p. Dep. NTIS $5.45.

Guidelines are needed for selecting appropriate methods of structural analyses to evaluate the seismic hazard of mixed-oxide fuel fabrication plants. This study examines the different available methods and their applicability to fabrication plants. These results should provide a basis for establishing guidelines recommending methods of analysis to ensure safe design against seismic hazards. Using the Westinghouse Recycle Fuels Plant as representative of future mixed-oxide fuel fabrication plants, critical structures and equipment (systems, components, and piping/ducting) were identified. These included the manufacturing building and 11 different pieces of equipment. After examination of the dynamic response characteristics of the building and the different methods available to analyze equipment, appropriate methods of analyses were recommended. Because critical equipment analysis and test methods generally use floor-response spectra as their seismic input loading, several methods used to generate floor spectra were also examined. These include the time-history approach and the Kapur and Biggs approximate methods. The examination included the effect of site characteristics and both horizontal and vertical structural response. (auth)

**11788** (WAPD-TM-1105) DETERMINATION OF STIFFNESS AND LOADING IN BOLTED JOINTS HAVING CIRCULAR GEOMETRY. Sharp, G. R. (Bettis Atomic Power Lab., West Mifflin, Pa. (USA)). Nov 1975. Contract E(36-1)-GEN-14. 51p. Dep. NTIS $5.00.

A synthesized technique to aid in predicting the overall dynamic or static response of a bolted connection to externally applied dynamic or static tractions is presented. The technique is a synthesis of an existing method for determining stiffness coefficients in a bolted connection together with concepts and analysis techniques presented in this document. The information presented is considered a "first step" in the development of an analytical technique for predicting the overall stiffness of a bolted connection having circular geometry. (auth)

**11789** SUPERFICIAL STRUCTURE FOR THE PROTECTION AGAINST REPEATED THERMAL SHOCKS. Descleve, P.; Megnin, J. C. (to Groupement pour les Activities Atomiques et Avancees (GAAA)). French Patent 2,217,291/A/. 9 Feb 1973. 6p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The method consists in providing the surface of a refractory member undergoing repeated thermal shocks, with a structure formed of unjointed parts spaced apart by grooves, then filling these grooves with a filter constituted by refractory fibers forming a compressible but impervious material. This can be applied to the protection of the outer surface of refractory blocks used for wrapping liquid metal treatment or handling apparatus and to immersed liquid metal pumps. (FR)

**11790** ELECTROLYTIC DISSOLVER. Wheelwright, E. J.; Fox, R. D. (to Energy Research and Development Administration). US Patent 3,901,786. B23p1/14. 26 Aug 1975. Filed date 10 Apr 1974. 10p.

This patent related to an electrolytic dissolver wherein dissolution occurs by solution contact including a vessel of electrically insulative material, a fixed first electrode, a movable second electrode, means for insulating the electrodes from the material to be dissolved while permitting a free flow of electrolyte therebetween, means for passing a direct current between the electrodes and means for circulating electrolyte through the dissolver. (auth)

**11791** INEXPENSIVE, CONVENIENT XENON DISPOSAL. Murphy, P. H.; Anderton, N. S. (Baylor Univ., Houston). Health Phys.; 29: No. 5, 779-780(Nov 1975).

An investigation of the feasibility of trapping $^{133}Xe$, after its use in a large medical facility, on activated charcoal and storing it for decay before release to the atmosphere is reported. The efficiency at about −10°C (the temperature of the freezer section of a conventional refrigerator) was found to be high. Thus the method appears to be a very effective, convenient and inexpensive way to control the release of this radioactive gas. (UK)

**11792** LOCAL STRESSES IN CYLINDRICAL SHELLS. Forman, B. F. Tulsa, OK; Pressure Vessel Handbook Publishing, Inc. (1975). 149p. (NP-20708).

A simple, practical design method of solving engineering problems of local stresses in cylindrical shells is presented. Computer calculated data for the most commonly used diameters and shell thicknesses are tabulated and plotted. Examples that illustrate the application of the various formulas and methods are included. (LCL)

**11793** THE BOARD'S LOW BACKGROUND FACILITIES. O'Riordan, M. C. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 13, 16-18(Oct 1975).

A description is given of the low background facilities available in the National Radiological Protection Board's new building at Harwell. The lay-out of the suite, its structural shielding (provided by steel sheet 15 cm thick made from steel plates salvaged from a 1915 naval wreck) and the use of specially selected building materials have had the combined effect of minimizing the ambient radiation level in the two steel chambers (one about 5m × 2m × 2m high and the other about 2m × 2m × 2m high). The equipment in the larger chamber is used for whole-body monitoring, thyroid monitoring and low-energy photon counting. The whole-body monitor consists of six sodium iodide crystals on a fixed ring around a moving stretcher. Low energy photon detectors have been developed and used for such measurements as plutonium in lungs and lead-210 in bones. An existing lead shielded sample counter is installed near the body measurements chamber for quick and approximate measurements of miscellaneous gamma ray emitting nuclides. Measurements on environmental and biological samples are made in the small chamber. The major piece of equipment here is a low-level gamma ray spectrometer consisting of a high efficiency germanium detector shielded by a cylindrical anti-coincidence guard of plastic scintillator. There is also a low level beta ray measuring device with some spectrometric capability, and alpha emitting radionuclides are measured by silicon surface-barrier detectors with good energy resolution. A central spectrum analysis system based on a PDP 11 small computer is situated alongside the steel chambers for data processing of the multiplicity of inputs generated by long counting periods and simultaneous operation of different detectors. Special precautions are taken to avoid contamination of the low background laboratory by patients and staff. (UK)

## Lasers

*Refer also to abstracts 13031 and 13068.*

**11794** (AD-455750) STUDIES ON HIGH POWER GaAs LASERS. Title, R. S. (IBM Watson Research Center, Yorktown Heights, N. Y. (USA)). Dec 1964. Contract Nonr-4136(00). 37p. NTIS $6.00.

An evaluation was made of GaAs laser material grown by the Czochralski method and by the horizontal Bridgman technique. Although the best of the Czochralski grown material is as good as that grown by the horizontal Bridgman method, the Bridgman grown material shows far less variability in performance from crystal to crystal than does the Czochralski grown material. Material grown by the Bridgman technique will be used for the remainder of this project. The studies of factors that influence high operation of GaAs lasers has continued. The influence of the geometry on laser performance is considered and theoretical and experimental data are given. Attempts to characterize laser material over smaller dimensions have continued and progress in this effort is reported. (auth)

**11795** (AD-634460) OPTIMIZATION OF THE GALLIUM ARSENIDE INJECTION LASER FOR MAXIMUM CW POWER OUTPUT. Vilms, J.; Wandinger, L.; Klohn, K. L. (Army

Electronics Command, Fort Monmouth, N. J. (USA). Electronic Components Lab.). 15 Dec 1965. 2p. NTIS.

In IEEE J. Quan. Elec., QE2: No. 4, 80-83(Apr 1966).

A basic mathematical model of the injection laser is employed to investigate several questions dealing with the maximum obtainable power output and factors which impose practical limitations on it. With the aid of the rate equations for electron and photon densities and a simple model of thermal resistance, it is shown that there is an optimum value of diode area WL and of the parameter $S = \alpha L/\ln(1/R)$, which suggests that the cw power output cannot be increased indefinitely with larger diodes. Rough numerical results are presented for cw operation at 77°K, assuming parabolic bands and band-to-band transitions without conservation of crystal momentum. (auth)

**11796** (AD-634507) HIGH-CURRENT PULSE GENERATOR FOR GALLIUM ARSENIDE LASER. Soper, W. L. (Harry Diamond Labs., Washington, D. C. (USA)). Apr 1966. 2p. (TM-66-3). NTIS $8.50.

A mercury wetted relay pulse generator and a pulse transformer have been built to drive gallium arsenide lasers in a fast pulse mode. The system is capable of 100-amp subnanosecond rise-time pulses at 800-Hz repetition rates. The design and performance are discussed. (auth)

**11797** (AD-642514) EFFECTS OF PRESSURE ON A SEMICONDUCTOR LASER RADIATION. Filho, J. F. R. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Electrical Engineering). 19 Sep 1966. Contract DA-31-124-ARO(D)-92. 146p. (TR-5). NTIS $6.00.

The results of the relativistic APW calculation of the band structure, momentum matrix elements and deformation potentials of the lead salts are used to calculate the effects of constant pressure on lasers made of these materials. Behavior of the frequency, polarization and relative gain of these lasers is calculated for several dopings, and injection levels, when isotropic and uniaxial pressures are applied. The effect of small dynamic pressure on semiconductor lasers is analyzed, resulting in a frequency modulation of the laser radiation. An experiment confirming this analysis was performed. A 2 Mc/s frequency modulation was introduced into a cw GaAs injection laser with an ultrasonic wave. This modulation was then detected with the use of a Fabry-Perot interferometer. A theoretical analysis of the limitations of the method of modulation demonstrated above was carried out with a regard to its device applications. (auth)

**11798** (AD-653962) RAY PENETRATING INTO THE FUTURE ULTRADISTANT COSMIC COMMUNICATION LIGHT PULSES OF SATELLITES. Aleksandrov, N. Translated from Nauchno-Tekhnicheskie Obshchestva, SSSR; 6: No. 8, 41-43(1964). 13p. (FTD-HT-66-439). NTIS $3.00.

The Lenin Prize for 1964 was awarded for the development of a gallium arsenide semiconductor laser. The semiconductor laser is almost 100% efficient and its microminiature size holds great promise for use in computers to achieve speeds of tens of billions of operations per second. Direct communication over distances of several light years is considered possible with the use of lasers. Satellites carrying a laser could be easily seen and accurately tracked both day and night. Applications of lasers in radio, telephone and television communications and in chemistry are mentioned. Quantum techniques make possible a construction of clocks accurate to one second in ten thousand years which could be used to conduct relativity experiments. Use of the laser beam as a metal working and surgical tool is mentioned. Long distance, high-efficiency transmission of energy by laser beam, especially in space where the absorbing and scattering effects of the atmosphere are avoided, is considered absolutely essential in the conquest of space. Direct conversion of matter into energy without explosion is possible using quantum devices. Quantum engines may utilize solar energy during space flight. (auth)

**11799** (AD-654837) MEASUREMENT OF PHOTON ABSORPTION LOSS IN THE ACTIVE AND PASSIVE REGIONS OF A SEMICONDUCTOR LASER. Hunsperger, R.; Ballantyne, J. (Cornell Univ., Ithaca, N. Y. (USA)). 20 Dec 1966. Contract DA-31-124-ARO(D)-364. 7p. NTIS.

In Appl. Phys. Lett., 10: No. 4, 130-132(15 Feb 1967).

A technique is described for measuring the photon absorption coefficients in the active and passive regions of an electron-beam-pumped semiconductor laser. Measurements made at 4°K on n-type, single-crystal GaAs indicate that photon loss in the active region is due to free carrier absorption, and that this absorption coefficient increases linearly from 2.5/cm to 47/cm as donor concentration is varied from $2.4 \times 10^{17}$/cc to $4.7 \times 10^{18}$/cc. For each case the active region absorption coefficient is less than that measured in the passive region, which varies from 354/cm to 98/cm over the same range of donor concentrations. The increased loss in the passive region is attributed to interband absorptive transitions. (auth)

**11800** (AD-658676) STUDY OF PHOTON LOSS IN THE ACTIVE AND PASSIVE REGIONS OF A SEMICONDUCTOR LASER. Interim Technical Report. Hunsperger, R. G. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). Jun 1967. Contract DA-31-124-ARO(D)-364. 148p. (MSC-675). NTIS $6.00.

Measurement and evaluation was made of the photon loss in the active and passive regions of a GaAs laser pumped by an electron beam. A theoretical expression was developed which gives the threshold current density required to produce lasing in an electron-beam-pumped laser when a portion of the length between Fabry-Perot surfaces was masked from the electron beam. This theoretical relation was experimentally verified by measurement of threshold current density as a function of masked length for numerous samples of GaAs at 4°K. On the basis of these measurements the photon loss coefficients in the active and passive regions of the laser crystals were determined. The loss coefficients were found to be strongly dependent on impurity doping concentration. In addition the loss coefficient in the active region was observed to be less than the loss coefficient in passive material. This is attributed to an inhibiting of interband absorptive transitions by the inverted population in the active region. (auth)

**11801** (AD-664168) RESEARCH ON A TUNNEL LASER. Ballantyne, J. M. (Cornell Univ., Ithaca, N. Y. (USA). Materials Science Center). Nov 1967. Contract DA-31-124-ARO(D)-364. 12p. (MSC-839). NTIS $3.00.

A summary is given of work which proceeded along three principal lines: (1) theoretical evaluation and prediction of tunnel-laser performance and operating characteristics; (2) measurement and interpretation of photon loss mechanisms in active and passive GaAs; and (3) experimental and theoretical investigation of electroluminescence in tunnel-laser structures utilizing GaAs as the semiconducting and silicon monoxide as the insulating components. (NTIS)

**11802** (AD-673783) SPECTRAL CHARACTERISTICS OF STIMULATED EMISSION OF GALLIUM ARSENIDE p-n JUNCTIONS. Wang, H. W.; Tsuang, W. H.; Wang, S. W.; Chuang, W. H.; P'eng, H. T. Translated from Wu Li Hsueh Pao; 21: No. 5, 1077-1079(1965). 8p. (FTD-HT-67-393). NTIS $3.00.

Measurements were made of the fine structure of gallium arsenide laser emission spectra and, also, of applied-current and thermal effects on the operating conditions of the lasers. (NTIS)

**11803** (AD-673983) STUDY OF OPTICAL INTERACTIONS IN SOLIDS. Semiannual Technical Summary Report. Braunstein, R.; Biscar, J. P.; Gratch, S.; Welkowsky, M. (California Univ., Los Angeles (USA). Dept. of Physics). May 1968. Contract Nonr-233(93). 69p. NTIS $6.00.

Multiphoton absorption in semiconductors was investigated with emphasis on the III-V compounds. It was shown that this mechanism can set an intrinsic upper limit to the power density transmittable through semiconductors. This mechanism is an effective means of optically pumping semiconductor lasers, can limit the power density obtainable from such devices, or can enable the fashioning of nonlinear optical elements. Laser action in a large volume of GaAs was excited by double-photon pumping using a Q-switched neodymium laser, yielding output power of the order of a MW/cm$^2$ at 8365 A at liquid nitrogen temperature. A new temperature anomaly of the threshold for stimulated Raman emission in liquid benzene was discovered and investigated. This effect indicates that self-focusing of the exciting laser beam does not explain previously observed Raman thresholds. (auth)

**11804** (AD-682464) OPTICAL QUANTUM GENERATORS AND PROSPECTS FOR THEIR APPLICATION IN OPTICAL RANGEFINDERS. Nazarov, V. M. Translated from Geod. Kartogr.; No. 8, 10-21(1967). 28p. (FTD-MT-24-151-68). NTIS $6.00.

The major portion of the article is devoted to a review of the historical development, theory, and physical characteristics of solid, gas, and semiconductor lasers. The remainder is a discussion of their possible application in optical range finders. Basic requirements for lasers in optical range finders are listed. Lasers operating in the pulsed mode are not suitable at present, because short pulses with well-defined shape cannot be produced with sufficient accuracy for time-of-flight measurements of distance. In general, solid and semiconductor lasers operating in the continuous mode are not suitable because of power and/or cooling requirements. Gas lasers operating in the infrared are also not suitable because of the high atmosphere absorption at

these wavelengths. However, helium-neon lasers operating at 632.8 nanometers have been successfully applied in optical range finders for measuring distances up to 20 to 30 km. A description of these experiments is presented. A recombination gallium arsenide photodiode operating at about 0.9 micrometers has been applied in the topographic range finder GD-314, which measures distances up to 2 km. (auth)

**11805** (AD-685783) JUNCTION EFFECTS IN COMPOUND SEMICONDUCTORS. Final Report, 15 September 1964–14 September 1967. Holonyak, N. Jr. (Illinois Univ., Urbana (USA). Dept. of Electrical Engineering). Jan 1969. Contract AF19(628)-4337. 15p. NTIS $3.00.

Instabilities and oscillation phenomena in bulk samples of Si compensated with Au, Co, or Zn are described. Vapor and epitaxial growth of $GaAs_{1-x}P_x$ and its dislocation properties are discussed. The optical, laser, and direct-indirect properties of $GaAs_{1-x}P_x$ are studied. The effect of donors on the direct-indirect transition is considered. Various ultrathin semiconductor platelet lasers are described, including optically pumped single mode and cr semiconductor lasers in the visible spectrum. The high transparency of platelet laser samples to their own output is shown to be due to exciton transition processes in II-VI semiconductors and due to a many-body, electron-hole-lattice interaction in III-V semiconductors. (auth)

**11806** (AD-686091) INTERNAL QUANTUM EFFICIENCY OF $GaAs_{1-x}P_x$ ELECTROLUMINESCENT DIODES. Scientific Interim Report No. 1, 1 December 1967–30 November 1968. Tietjen, J. J.; Nuese, C. J.; von Philipsborn, H. (RCA Labs., Princeton, N. J. (USA)). 30 Nov 1968. Contract F19628-68-C-0190. 32p. NTIS $6.00.

The objective of this contract has been to study and to optimize the internal quantum efficiency of $GaAs_{1-x}P_x$ electroluminescent diodes, particularly those emitting visible radiation. This investigation has involved the effects of alloy composition, impurity types and concentrations, compositional grading, junction abruptness, and crystal growth conditions. Average junction efficiencies have been increased by an order of magnitude by optimizing the various parameters. As a result, planar diodes, emitting at 6800 Å, can be prepared with room-temperature external efficiencies of about 0.1%. (auth)

**11807** (AD-686452) DISTRIBUTION OF ENERGY STATES AT BAND EDGES IN GaAs LASER DIODES. Burrell, G. J.; Moss, T. S.; Hetherington, A. (Royal Aircraft Establishment, Farnborough (UK)). Nov 1968. 28p. (RAE-TR-68267). NTIS $6.00.

Experimental observations of gain perpendicular to the junction in a GaAs laser diode at 80°K have been related to the spontaneous emission rate in order to determine the splitting of the quasi-Fermi levels appropriate to the active region of the junction. An analysis of the observed spontaneous emission spectra (corrected for self absorption) has shown that radiative recombination results from transitions between a pair of exponential band tails in which the density of states is of the form rho(E) is proportional to exp $E/E_0$. A study of Zn-diffused diode made from Se-doped GaAs gave rise to values for the parameter $E_0$ of 8.3 MeV for the conduction band and 8.0 MeV for the valence band. (auth)

**11808** (AD-691499) STUDY OF OPTICAL INTERACTIONS IN SOLIDS. Final Technical Report, 1 September 1966–31 August 1968. Braunstein, R.; Biscar, J. P.; Gratch, S.; Welkowsky, M. (California Univ., Los Angeles (USA). Dept. of Physics). 28 Jul 1968. Contract Nonr-233(93). 64p. NTIS $6.00.

Multiphoton absorption in semiconductors was investigated with emphasis on the III-V compounds. It was shown that this mechanism can set an intrinsic upper limit to the power density transmittable through semiconductors. Laser action in a large volume of GaAs was excited by double-photon pumping using a Q-switched neodymium laser, yielding output power of the order of a $MW/cm^2$ at 8365 Å at liquid nitrogen temperature. A new temperature anomaly of the threshold for stimulated Raman emission in liquid benzene was discovered and investigated. The first observation of infrared stimulated emission associated with optical phonons of a liquid was reported. This was seen at 5 micrometers from benzene. In addition, induced transparency by coherent optical phonons was observed. A new technique of frequency-modulated spectroscopy was developed which enables one to readily obtain the first or higher derivatives of any optical spectra. (auth)

**11809** (AD-691922) PHOTON LOSS IN THE ACTIVE AND PASSIVE REGIONS OF A SEMICONDUCTOR LASER. Hunsperger, R. (Cornell Univ., Ithaca, N. Y. (USA)). 26 Aug 1968. Contract DA-31-124-ARO(D)-364. 14p. NTIS.

In Solid-State Electron., 12: 215-224(1969).

The photon loss in the active and passive regions of an electron-beam-pumped GaAs laser has been measured by masking a portion of the length between Fabry-Perot surfaces. A theoretical expression for threshold has been developed, and experimental measurement of threshold current density as a function of masked length has been made for several different n and p-doped samples of GaAs at 4°K. The loss coefficients have been found to be strongly dependent on impurity doping concentration. The loss coefficient in the active region has been observed to be less than the loss coefficient in passive material. This is attributed to an inhibiting of interband absorptive transitions by the inverted population in the active region. (auth)

**11810** (AD-694366) INFLUENCE OF SERIES RESISTANCE OF GaAs LASER POWER OUTPUT AND HEAT LOSSES. Klohn, K. L.; Wandinger, L. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Aug 1969. 20p. (ECOM-3161). NTIS $3.00.

A theoretical thermodynamic study was made of a typical cw laser diode structure, at cryogenic temperature, to determine the influence of series resistance (with emphasis on contact resistance) on the power output, power efficiency and power heat losses. The heat losses are due to threshold power, an internal quantum efficiency less than one, reabsorption of coherent light by free carriers and ohmic heating. It was shown that the incorporation of a high surface impurity concentration on both the n- and p-sides of a laser diode leads to a substantial reduction in the contact resistance and subsequently series resistance, thereby resulting in a significant improvement in power output and power efficiency. (auth)

**11811** (AD-695945) CERTAIN CHARACTERISTICS OF A GaAs OPTICAL QUANTUM AMPLIFIER. Moma, Yu. A.; Abramov, V. S.; Kobzev, V. V. 1 Jul 1969. Translation of pp 141-145 from Poluprovodnikove Pribory v Tekhnike Elektrosvyazi. Sbornik Statei, 1968. (FTD-MT-24-127-69). 12p. NTIS $3.00.

Results of the measurement of amplification factors of a semiconductor optical quantum amplifier OKU based on gallium arsenide, in pulse conditions at the temperature of liquid nitrogen are presented. Conclusions are drawn as to the prospects of the application of OKU in optical communication lines. (auth)

**11812** (AD-698281) ELECTRICAL NOISE IN GaAs DIODE LASERS. Final Report, October 1968–January 1969. Royt, T. R. (Naval Research Lab., Washington, D. C. (USA)). 30 Oct 1969. 67p. (NRL-6980). NTIS $6.00.

Measurements were made of the current fluctuations at 30 MHz generated in a GaAs diode during luminescent and lasing operation. It was found that thermal noise predominates over other effects. Calculations indicate that this dominance is due to the small junction resistances which occur at helium temperatures. In addition, the line loss in the transmission system was found to limit the measurement system sensitivity. (auth)

**11813** (AD-702079) INTENSITY MODULATED LIGHT SOURCE USABLE TO 100 MHz. Final Report, December 1968–July 1969. Crosswy, F. L.; Kalb, H. T. (Arnold Engineering Development Center, Arnold Air Force Station, Tenn. (USA)). Mar 1970. Contract F40600-69-C-0001. 23p. (AEDC-TR-70-34). NTIS $6.00.

A gallium arsenide light emitting diode, with emission wavelength range from 6000 to 7000 A, and a driver amplifier assembly are used to simulate the signal produced by a Doppler shift laser velocimeter (LV). The light source device is then used to check the entire electronics portion of the LV without assembling the LV optical components. The frequency domain optical response of the device was found to be flat from 0 to about 15 MHz. However, usable optical output was obtained at 100 MHz. (auth)

**11814** (AD-714397) PULSED GaAs LASER SYSTEM FOR SEMICONDUCTOR CARRIER LIFETIME MEASUREMENTS. Kannewurf, C. R.; Motamedi, M. E. (Northwestern Univ., Evanston, Ill. (USA)). 9 Jul 1969. Contract N00014-67-A-0356-0003. 4p. NTIS.

In IEEE Trans. Instrum. Meas., IM-19: No. 1, 6-9(Feb 1970).

An electronic system is described for controlling a semiconductor laser, which is convenient for measuring semiconductor carrier lifetimes of 500 ns or greater by the photoconductive decay method with the laser providing the sample illumination. Particular attention is given to the circuit of the power pulse generator, which was designed to operate the laser above threshold and to provide a means of controlling the output intensity of the laser radiation. (auth)

**11815** (AD-714533) STUDY AND DEVELOPMENT OF LUMINESCENCE AND LASER OPERATION IN VARIOUS III-V AND II-VI SEMICONDUCTORS. Final Report, 1 February 1969–31 May 1970. Holonyak, N. Jr. (Illinois Univ., Urbana (USA).

Materials Research Lab.). Jul 1970. Contract F33615-69-C-1334. 56p. NTIS $3.00.

Carrier recombination and laser processes in semiconductors, mainly GaAs, are described. Measurements on GaAs over a wide doping range are reported. The electron-hole-lattice interaction and its 16 meV reduction of the laser photon energy in GaAs is ascribed in large part to electron-electron interaction. Laser operation of p-n junctions in GaAs doped with amphoteric impurities is demonstrated. Optical pumping with a Ga(AsP) laser diode has been used to excite photoluminescence and laser operation of n+/n/n+ layered structures, and to perform spectroscopic studies on Gunn oscillator wafers. A method is described for coupling laser beams into thin structures (about one micrometer) and for easy coupling of optical signals between various thin structures. (auth)

**11816** (AD-715101) CONFERENCE ON SOLID STATE DEVICES, EXETER, 15–18 SEPTEMBER 1970. Annual Conference Report No. 4. Rowlands, R. O. (Office of Naval Research (USA). London Branch Office). 6 Nov 1970. 13p. (ONRL-C-28-70). NTIS $3.00.

The topics covered the following areas: the economics of large scale integration; crystal growth; computer aided design; microwave amplifiers; lasers; semiconductor memories; and, special devices. (auth)

**11817** (AD-715140) RADIATION EFFECTS RESEARCH PROGRAM. Grannemann, W. W.; Allen, R. C. Jr.; Boatwright, L. T.; Byatt, W. J.; Southward, H. D. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Sep 1970. Contract N00014-68-A-0158. 302p. (EE-177(70)ONR-005). NTIS $6.00.

The report includes radiation effects on GaAsP and GaP Schottky barrier diodes; fabrication and electrical testing of Zn-Si and Zn-GaAsP Schottky barrier diodes; the effects of neutron and gamma irradiation on diffused GaAs laser diodes; radiation damage to epitaxial silicon measured by micro-Hall devices; Hall effect in dielectric materials; conductance measurements on metal-insulator-semiconductor capacitors; metal-insulator-semiconductor (MIS) capacitor studies; transistor modeling; transient radiation effects in silicon controlled rectifiers; theory of avalanche breakdown in silicon II; particle transport and band structure within imperfect crystal; and transport equations with variable coefficients. (auth)

**11818** (AD-719481) INVESTIGATION OF ULTRASHORT LIGHT PULSES BY ELECTRONIC-OPTICAL CONVERTOR WITH TIME SCAN. Basov, N. G.; Drozhbin, Yu. A. 10 Nov 1970. Translation of Russian Report. (FSTC-HT-23-522-70). 9p. NTIS $3.00.

The report describes the type FER-2 photoelectronic recorder with electronic-optical convertor and the results of investigation of the time parameters of semiconductor lasers, produced, using the recorder. The effect of the recorder is based on the usage of the method of electronic-optical chronography. The FER-2 allows the time relationships of light pulses of one-time processes to be determined with an accuracy to $2 \times 10^{-11}$s. (auth)

**11819** (AD-721372) BEHAVIOR OF LASER MODES IN A MEDIUM WITH TIME VARYING DIELECTRIC CONSTANT. Whitney, C. G. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Electrical Engineering). 25 Aug 1970. Contract DA-31-124-ARO(D)-92. 170p. (TR-9). NTIS $3.00.

The effect, on semiconductor laser modes, of a time-varying modulation of the complex dielectric constant of the active region of the laser, is considered. It is seen that the main effect is to produce frequency modulation associated with modulation of the real part of the dielectric constant while modulation of the imaginary part gives rise to amplitude modulation. Two methods for producing the modulation are considered. The first, pressure via ultrasonic waves, produces pure frequency modulation in impure material. The second, modulation of the injection, results in both amplitude and frequency modulation. Experiments to confirm this analysis were carried out on a cw GaAs injection laser. The modulated laser spectrum was observed with a Fabry-Perot Interferometer. High resolution measurements on the pulsed spectral shift of a GaAs laser at 77 and 4.2°K were performed using a Fabry-Perot interferometer. The feasibility of detecting modulation on a pulsed semiconductor laser was demonstrated. (auth)

**11820** (AD-721654) OPTICAL EXPERIMENTS WITH LASER SOURCES. Semiannual Technical Report, 30 September 1970–28 February 1971. Faust, W. L. (University of Southern California, Los Angeles (USA). Dept. of Electrical Engineering). 30 Mar 1971. Contract DAHC04-69-C-0003. 13p. NTIS $3.00.

The semiannual report presents a discussion of technical findings and accomplishments for the period Sept. 30, 1970, through Feb. 28, 1971, covering $CO_2$ laser work, $CaF_2H(^-)$ experiment, light scattering from semiconductors, associated with impurities, and far infrared work. (NTIS)

**11821** (AD-726139) BIBLIOGRAPHY OF SOVIET LASER DEVELOPMENTS. Interim Report No. 3, January–March 1971. Allen, L. L.; Hibben, S. G. (Informatics Tisco, Inc., Riverdale, Md. (USA)). 28 Apr 1971. Contract F44620-70-C-0081. 57p. NTIS $3.00.

Of all material reviewed, the major yield has been from the approximately 300 periodicals which are known to report the most advanced and interesting findings in Soviet laser technology. The period covered is the first quarter of 1971, and includes all laser-related articles received in that interval. The structure and selection criteria are the same as used in the first report. Somewhat broadened selection criteria have been used for items pertinent to chemical lasers, in view of the expanding possibilities in this technology. The literature search also revealed an increased emphasis on holographic studies, as well as on uses of stimulated Raman scattering effects in spectroscopy. Other items worthy of mention are two articles on ultraviolet lasers and one on use of an argon ion laser for underwater TV transmission. (auth)

**11822** (AD-734160) RADIATION EFFECTS RESEARCH PROGRAM. Annual Report, 1 September 1970–31 August 1971. Grannemann, W. W.; Allen, R. C. Jr.; Boatwright, L. T.; Byatt, W. J.; Southward, H. D. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Sep 1971. Contract N00014-68-A-0158. 173p. (EE-192(71)ONR-005). NTIS $3.00.

Topics discussed include radiation effects on GaAsP and GaP Schottky barrier diodes; diffusion of Zn in GaAsP; low volume depletion region Schottky barrier diodes; neutron and gamma radiation effects in GaAs laser diodes and bulk materials; MIS (metal-insulator-semiconductor) studies; fabrication and testing of GaAsP MIS capacitors; thermal oxidation of GaAsP; electron beam irradiation studies; magnetoresistance and radiation effects on electron beam evaporated high mobility thin films of indium antimonide; Hall effect in dielectric material; microhall device studies; radiation effects on epitaxial silicon; semiconductor modeling study; electrons in disordered crystals; and application of invariant imbedding methods to problems of transport theory and wave propagation. (NTIS)

**11823** (AD-735463) NEW POSSIBILITIES FOR THE USE OF SEMICONDUCTOR DIODE LASERS. Kiss, G. Translated from 21: No. 9, 275-278(1970). 13p. (FTD-HC-23-979-71). NTIS $3.00.

The possibility that a fast operating computer can be made with the use of diode lasers is examined. Starting with the physical bases of the operation of diode lasers, their use in telecommunications engineering is briefly outlined. Finally the use of the couples laser photodiode as fast operating logic circuit elements is discussed. (auth)

**11824** (AD-735939) NEUTRON IRRADIATION EFFECTS ON DIFFUSED GaAs LASER DIODES. Noel, B. W.; Barnes, C. E.; Southward, H. D. (New Mexico Univ., Albuquerque (USA). Bureau of Engineering Research). Sep 1971. Contract N00014-68-A-0158. 245p. (EE-186(71)ONR-005). NTIS $3.00.

A detailed study has been made of the pre- and post-irradiation electrical and optical properties of diffused GaAs laser diodes. The emphasis of the study was on the current and electroluminescence (EL) mechanisms existing in the diodes below lasing threshold and the effects of fast neutron irradiation on those mechanisms. Changes were observed in the current-voltage characteristics and in the EL spectra at several temperatures between 75 and 300°K. The irradiations were performed at low temperature (140°K) to a fluence of $1.8 \times 10^{15}$ nvt (10 keV). Capacitance-voltage measurements were used to monitor the majority-carrier concentrations before and after irradiation. (auth)

**11825** (AD-736002) ELECTROOPTICAL PULSE-PHASE GDFI-1 RANGE FINDER WITH SEMICONDUCTOR OUTPUT UNIT. Deryagin, V. N.; Berkalov, S. V. Translated from Opt.-Mekh. Prom-st.; 37: No. 6, 27-29(1970). 9p. (FSTC-HT-23-817-71). NTIS $3.00.

A pulse-phase GaAs laser range finder is described. (auth)

**11826** (AD-737941) OPTICALLY PUMPED ROOM-TEMPERATURE $In_xGa_{1-x}As$ LASERS. Rossi, J. A.; Chinn, S. R.; Mooradian, A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 16 Nov 1971. Contract F19628-71-C-0230. 3p. (JA-3965). NTIS.

Several compositions of $In_xGa_{1-x}As$ have been operated as optically pumped lasers at room temperature. Coherent emission has been observed out to 1.12 micrometers, corresponding to

an alloy composition of x approximately equal to 0.20. Typical total-power-conversion efficiencies are measured to be 0.6%. (auth)

**11827** (AD-743517) STUDY OF THE INTERACTION OF INTENSE PICOSECOND LIGHT PULSE WITH MATERIALS. Quarterly Technical Report, 21 December 1971–21 March 1972. Lee, C. H.; Park, Y. H. (Maryland Univ., College Park (USA)). 1 May 1972. 64p. (TR–9). NTIS $3.00.

Laser action in GaAs using a Nd: glass laser as a two photon pump was investigated. External mirrors were employed to form the optical cavity. Laser action in GaAs was observed in the following experiments: first, a narrowing of the emission spectrum was observed, and secondly, the output power dependence upon the input power was studied. The main advantage of this method of optical excitation is the possibility of obtaining an inverse population throughout a large semiconductor volume. The advantage of using an external mirror resonator is that it may be possible to Q-switch the GaAs laser and to use the adjustable cavity for various other purposes. (auth)

**11828** (AD-747003) LASER LOCATING DEVICES. Petrovskii, V. I.; Pozhidaev, O. A. 21 Jun 1972. Translated by A. L. Peabody from Russian Monograph Moscow, 1969. (FSTC-HT–23-943-71). 88p. NTIS $6.50.

The principles upon which laser locating devices operate are described. The materials used as lasers and the methods which can be employed to modulate the laser beam are discussed. The use of lasers in locating systems for determining range, angular coordinates, and contour of a target object, and for tracking such objects after search has concluded are examined. The examples of operating lasers which they cited specifically and the suggestions for future development of laser technology are all taken from American publications. (auth)

**11829** (AD-747524) FREQUENCY MODULATED LASER COMMUNICATIONS SYSTEM. Nittle, J. J. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1972. 58p. NTIS $3.00.

Thesis.

The design of a system for point-to-point voice communications using a frequency modulated diode laser as the transmitter is presented. Theories are discussed for the GaAs semiconductor laser, the laser pulse circuits, the p-i-n silicon photodiode detector, and the frequency demodulator. Designs of the elements of the system and some experimental results are presented. Operation of a complete system is discussed. (auth)

**11830** (AD-750016) UNCOOLED GaAlAs LASER ILLUMINATOR FOR NIGHT VISION APPLICATIONS. Lyttle, W. B.; Repasy, A. J.; Gibson, S. B. (Army Electronics Command, Fort Belvoir, Va. (USA). Night Vision Lab.). 1971. 6p. NTIS.

A lightweight, portable semiconductor laser illuminator is described that represents the first application for arrayed GaAlAs laser diodes operating at 300°K. This prototype model clearly demonstrates the feasibility of radiation convection cooled illuminators producing radiant power outputs in the wavelength region of 850 nm to match the spectral sensitivity of S-25 image intensifier tubes. This illuminator, emitting 80 mW with an overall power efficiency of 0.53%, weighs only 1.91 lb. (auth)

**11831** (AD-752005) DOUBLE-HETEROSTRUCTURE GaAs:Si DIODE LASERS. Rossi, J. A.; Hsieh, J. J. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 9 Jun 1972. Contract F19628-73-C-0002. 4p. (JA–4071). NTIS.

In Appl. Phys. Lett., 21: No. 6, 287-289(15 Sep 1972).

Double-heterostructure diode lasers with Si-doped active regions have exhibited laser action within the wavelength range 9100 to 9500 Å under pulsed room-temperature conditions. Threshold current densities are typically 4000 to 11,000 A/cm$^2$, and total power conversion efficiencies are approximately 1 to 3%. (auth)

**11832** (AD-753752) EXPERIMENTAL TESTS OF PROPOSED MECHANISM FOR GRADUAL DEGRADATION OF GaAs DOUBLE-HETEROSTRUCTURE INJECTION LASERS. Newman, D. H. (Post Office Research Dept., London (UK)). 3 Jul 1972. 6p. NTIS.

In IEEE J. Quan. Electron., QE8: No. 3, 379-382(Mar 1972).

Degradation rates of double-heterostructure GaAs lasers have been measured and found to vary superlinearly with the injected current density above threshold. The results are discussed in the context of the Gold-Weisberg phonon-kick and the extended Logini field-inhibited diffusion degradation mechanisms. (auth)

**11833** (AD-754237) SECOND EUROPEAN SOLID STATE DEVICE RESEARCH CONFERENCE, HELD AT THE UNIVERSITY OF LANCASTER, 12–15 SEPTEMBER 1972. Edelsack, E. A. (Office of Naval Research (USA). London Branch Office). 5 Dec 1972. 10p. (ONRL-C–18-72). NTIS $3.00.

The Second European Solid State Device Research Conference (ESSDERC) was held at the University of Lancaster from Sept. 12 to 15, 1972. There were 300 attendee representatives of almost every major solid state laboratory in the world (except Russia). This report discusses some of the papers presented at the meeting. (auth)

**11834** (AD-758940) EFFICIENT OPTICALLY PUMPED InP AND $In_xGa_{1-x}As$ LASERS. Rossi, J. A.; Chinn, S. R. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 1972. Contract F19628-73-C-0002. 3p. (JA-4048). NTIS.

In J. Appl. Phys., 43: No. 11, 4806-4807(Nov 1972).

Optically pumped InP and $In_xGa_{1-x}As$ are operated as pulsed room-temperature lasers with output power densities or = $10^5$ W/cm$^2$ and total power-conversion efficiencies of up to 4%. (auth)

**11835** (AD-758950) OPTICALLY PUMPED ROOM-TEMPERATURE GaAs LASERS. Chinn, S. R.; Rossi, J. A.; Wolfe, C. M.; Mooradian, A. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 7 Jul 1972. Contract F19628-73-C-0002. 8p. NTIS.

In J. Quant. Electron., QE-9: No. 2, 8(Feb 1973).

The results of an experimental study of room-temperature bulk optically pumped GaAs lasers are reported. The feature of particular interest was the efficient conversion of the incident pump light into lasing radiation emitted from the inverted bulk platelets of GaAs. (auth)

**11836** (AD-766233) SOLID STATE RESEARCH, 1973:2. Quarterly Technical Summary Report, 1 February–30 April 1973. McWhorter, A. L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 May 1973. Contract F19628-73-C-0002. 68p. NTIS $3.50.

The report covers in detail the solid state research work of the Solid State Division at Lincoln Laboratory for the period Feb. 1 through April 30, 1973. The topics covered are solid state device research, quantum electronics, materials research, physics of solids, and microelectronics. The microsound work is sponsored by ABMDA and is reported under that program. (auth)

**11837** (AD-766245) DEFECT LEVELS IN NEUTRON-IRRADIATED GaAs SCHOTTKY DIODES AND LASER DIODE DEGRADATION. Physical Sciences Research Papers. Ludman, J. E. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass. (USA)). 31 May 1973. 81p. (AFCRL-TR-73-0344; AFCRL-PSRP-550). NTIS $3.75.

GaAs Schottky and laser diodes were irradiated with high energy neutrons and the resultant trap and defect structure analyzed. The Schottky diodes were irradiated with a high-energy neutron beam from a Van de Graaff accelerator, and the laser irradiation was done in a nuclear reactor. The defect structure was shown to consist of energetically discrete trap levels, but the levels were found not to operate independently. A new defect model is proposed based on coupled defect levels and is shown to be in good agreement with the observations. On the basis of this model, values for the discrete trap levels were determined. Experimentally, Schottky diodes were cooled to temperatures in the region 78, to 178°K, the back bias was turned off and on again, and the capacitance versus time (capacitance decay) was monitored. These measurements are used to derive the activation energies of the trap levels. Trap levels are found at 175, 220, 325, 380 and 460 mV below the conduction band. Several general numerical techniques are developed for the purpose of fitting experimental data to both the independent-level and coupled-level decay models. (auth)

**11838** (AD-770293) SOLID STATE RESEARCH, 1973:3. Quarterly Technical Summary, 1 May–31 July 1973. McWhorter, A. L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 30 Oct 1973. Contract F19628-73-C-0002. 76p. NTIS $3.75.

The report covers in detail the solid state research work of the Solid State Division at Lincoln Laboratory for the period May 1, through July, 1973. The topics covered are solid state device research, quantum electronics, materials research, physics of solids, and microelectronics. The microsound work is sponsored by ABMDA and is reported under that program. (auth)

**11839** (AD-771141) GaAs LARGE OPTICAL CAVITY (LOC) LASER DIODE FOR COMMUNICATIONS SYSTEMS. Interim Technical Report No. 1, 15 November 1972–15 May 1973. O'Brien, J. T. (RCA Electronic Components, Lancaster, Pa. (USA)). Sep 1973. Contract DAAB07-73-C-0062. 51p. NTIS $3.50.

Work has been initiated on the development of an LOC laser diode to be used as the transmitting component for an optical

communicator. During this first six month period, a package has been designed which meets the device requirements of low thermal resistance and low self inductance. A liquid phase epitaxial process has been developed to produce the multiple layer structures required to form the LOC lasing p-n junctions. Results of four layer structures are tabulated. Cross sections of typical layers are shown as photographed with a scanning electron microscope. Operating devices were constructed in which lasing was achieved at pulse repetition rates of 2 MHz and a duty cycle of 4%. Plans for effort in future intervals are given. (auth)

**11840** (AD-771152) COMPONENTS FOR INTEGRATED OPTICS. Somekh, S.; Yariv, A. (California Inst. of Tech., Pasadena (USA)). Aug 1973. 156p. NTIS $4.75.

Recent progress in the fabrication of low attentuation optical fibers raises the attractive possibility of optical communcations via these waveguides. Integration of different optical functions on one substrate in the form of optical circuits will form ideal terminals for such a communication network. The theory, fabrication and performance of a few "building stones" of such optical circuits are discussed. Optical directional couplers capable of coupling light from one channel to another are described and their use as switches is discussed. Distributed feedback for integrated lasers is analyzed. Laser action in a GaAs waveguide, in which distributed feedback was supplied by corrugations fabricated on the surface, is described. Longitudinal and transverse mode control of such a laser is also discussed. (auth)

**11841** (AD-771735) EFFECT OF FORMATION CONDITIONS ON THE ELECTRICAL PROPERTIES OF EPITAXIAL P-N JUNCTIONS IN GALLIUM ARSENIDE. Kulish, U. M. Translated from Arsenid Galliya; No. 3, 152-162(1970). 12p. (FSTC-HT-23-1986-72). NTIS $3.00.

Electrical properties were investigated of p-n junction in GaAs obtained by the method of liquid epitaxy. The electrical characteristics of p-n junctions obtained in a narrow temperature interval depend on the epitaxy temperature, which is explained by the corresponding dependences of the solidus curves of the corresponding quasibinary systems. The crystallographic orientation of the substrate significantly influences the electrical and optical properties of laser junctions. Acceptor impurities exert various effects on the electrical and optical properties of epitaxial laser semiconductor diodes. (auth)

**11842** (AD-771902) HIGH-POWER NARROW-LINEWIDTH OPERATION OF GaAs DIODE LASERS. Rossi, J. A.; Chinn, S. R.; Heckscher, H. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 9 Mar 1973. Contract F19628-73-C-0002. 5p. NTIS.

In Appl. Phys. Lett., 23: No. 1, 25-27(1 Jul 1973).

By using a dispersive element in an external cavity, it was found possible for pulsed room-temperature GaAs diodes to emit high output power (3W) into a narrow linewidth (0.4 Å). This narrow-band output is continuously tunable over an approximately 100Å range with only a moderate variation in output power. Significantly, these qualities are preserved even at high output power densities ($3 \times 10^6$ W/cm$^2$). (auth)

**11843** (AD-772153) THRESHOLD, SPECTRAL, AND OUTPUT POWER CHARACTERISTICS OF GaAs/$Ga_{1-x}Al_xAs$ SINGLE-HETEROSTRUCTURE DIODE LASERS. Rossi, J. A.; Heckscher, H.; Chinn, S. R. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 11 Jun 1973. Contract F19628-73-C-0002. 4p. (JA-4216). NTIS.

In Appl. Phys. Lett., 23: No. 5, 257-259(1 Sep 1973).

By using an antireflection-coated GaAs diode in conjunction with a diffraction grating, it is shown that the diode threshold current and output power are strong functions of the lasing wavelength. The diode threshold is lowest at the longer wavelengths at which it is possible to lase the diode, but the total output power in this wavelength region is limited. The data are useful in interpreting the characteristics (spectral, threshold, and power) of a normal uncoated diode laser. (auth)

**11844** (AD-772226) TIME DELAYS IN EXTERNAL-CAVITY-CONTROLLED GaAs/$Ga_xAl_{1-x}As$ SINGLE-HETEROSTRUCTURE DIODE LASERS. Rossi, J. A.; Heckscher, H.; Stillman, G. E.; Chinn, S. R. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 11 Jun 1973. Contract F19628-73-0002. 5p. (JA-4217). NTIS.

In Appl. Phys. Lett., 23: No. 5, 254-256(1 Sep 1973).

By using a wavelength-selective external cavity, the time delay and Q-switching effects commonly observed in homojunction and single-heterostructure diodes are shown to be strongly dependent on the lasing wavelength. The data suggest that the energy distribution of injected electrons as a function of time is an important factor in determining the diode delay behavior. (auth)

**11845** (AD-775825) STUDY OF THE INTERACTION OF INTENSE PICOSECOND LIGHT PULSES WITH MATERIALS. Final Report, 23 December 1969-21 June 1973. Lee, C. H. (Maryland Univ., College Park (USA)). 15 Feb 1974. 15p. NTIS $3.00.

A summary of the work performed during the period of this grant is presented. The two-photon and three-photon photoconductivity effects in various semiconductors were studied. The effect was then applied to measure the ultrashort optical pulses. Two-photon pump GaAs bulk laser action was demonstrated. A theoretical calculation on the optical third harmonic generation with broad band picosecond pulses was made. Finally various aspects of the nonlinear optical interaction at the boundary of nonlinear media were investigated. The data agreed well with Bloembergen and Pershan's theory. The observation of the nonlinear Brewster's angle was reported for the first time in a transparent medium. (auth)

**11846** (AD-777557) TEMPERATURE DEPENDENCE OF THE LASING TRANSITION IN HIGH-PURITY GaAs. Chin, S. R.; Rossi, J. A.; Wolfe, C. M. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 10 Sep 1973. Contract F19628-73-C-0002. 5p. (JA-4270). NTIS.

In Appl. Phys. Lett., 23: No. 12, 699-701(15 Dec 1973).

The lasing energy of optically pumped high-purity GaAs from 2 to 300°K was measured. Low-temperature results show strong many-body effects in the band-to-band lasing below the single-particle band-gap energy, and the high-temperature data indicate that the lasing energy approaches the band gap measured by photoconductivity. (auth)

**11847** (AD-778086) SOLID STATE RESEARCH, 1973:4. Quarterly Technical Summary, 1 August-31 October 1973. McWhorter, A. L. (Massachusetts Inst. of Tech., Lexington (USA). Lincoln Lab.). 15 Nov 1973. Contract F19628-73-C-0002. 92p. NTIS $4.00.

The report covers in detail the solid state research work of the Solid State Division at Lincoln Laboratory for the period 1 August through 31 October 1973. The topics covered are solid state device research, quantum electronics, materials research, physics of solids, and microelectronics. The microsound work is sponsored by ABMDA and is reported under that program. (auth)

**11848** (AD-779472) GaAs LARGE OPTICAL CAVITY (LOC) LASER DIODE FOR COMMUNICATIONS SYSTEMS. Interim Technical Report No. 2, 16 May-15 November 1973. O'Brien, J. T. (RCA Electronic Components, Lancaster, Pa. (USA)). Mar 1974. Contract DAAB07-73-C-0062. 58p. NTIS $3.75.

The development of a LOC double heterojunction laser diode to be used as the transmitting component for an optical communicator is discussed. A thermal analysis of the LOC diode, mounted in the microwave package, is given along with measurements of the total device inductance. A new epitaxial system has been constructed which incorporates an all-electronic temperature control and programming system. Results of both four and five layer epitaxial junctions are discussed. Pulse driver developments and performance characteristics of the laser devices are given at duty cycles up to 3% at pulse repetition frequencies in excess of 2.5 MHz. Work has been initiated on the construction of a two position life test rack capable of operating the LOC laser diodes at currents up to 15 A and pulse repetition rates of 5.0 MHz at 10 ns pulse width. (auth)

**11849** (AD-783669) TECHNOLOGICAL FORECAST FOR GALLIUM ARSENIDE LASERS. Olson, H. M. (Naval Postgraduate School, Monterey, Calif. (USA)). Jun 1974. 160p. NTIS $11.00.

Thesis.

A technological forecast for GaAs injection lasers operating at room temperature is made. It indicates significant technological progress followed by widespread use for optical waveguide communications in the early 1980's. Extrapolated values for power, efficiency, lifetime, threshold current, and cost per watt are tabulated for the years 1976 and 1980. The trend extrapolation techniques based on the different assumptions that technological progress advances exponentially with time and that technological progress advances exponentially with cumulative production are compared. The technological progress function which uses patent output as a measure of cumulative production is determined to be the best measure in the case of the injection laser. (auth)

**11850** (AD-784341) GaAs LARGE OPTICAL CAVITY (LOC) LASER DIODE FOR COMMUNICATIONS RECEIVERS. Final Technical Report, 16 November 1972-20 March 1974. O'Brien, J. T. (RCA Electronic Components, Lancaster, Pa. (USA)). Jul 1974. Contract DAAB07-73-C-0062. 75p. NTIS $6.75.

The development of a LOC double heterojunction laser diode for use as the transmitting component for an optical communicator is discussed. A thermal analysis of the LOC diode, mounted in the microwave package, is presented along with measurements of the total device inductance. A new epitaxial system was constructed which incorporates an all-electronic temperature control and programming system. Results of both four and five layer epitaxial junctions are discussed. Pulse driver developments and performance characteristics of the laser devices are given at duty cycles in excess of 5% at pulse repetition frequencies up to 5.0 MHz. A two position life test rack was constructed for the purpose of operating the LOC laser diodes at currents up to 15 A and pulse repetition rate of 5.0 MHz at 10 ns pulse width. Some preliminary life test data is presented along with recommendations for extending the performance of the device. (auth)

**11851** (AD-808600) SEMICONDUCTOR LASER DIGITAL DEVICES. Final Report, 2 August 1965–31 August 1966. Kosonocky, W. F.; Cornely, R. H. (RCA Labs., Princeton, N. J. (USA)). Jan 1967. 99p. NTIS $3.00.

GaAs lasers are considered as components for digital circuits. An evaluation is made of GaAs laser materials prepared by solution-regrowth techniques, diffusion of zinc into an n-type substrate, and vapor-phase epitaxy. Developed techniques for the preparation of GaAs laser components and their interconnections are described. These include preparation of electrically isolated, optically coupled laser junctions and construction of directly coupled GaAs laser devices. Experimental results are presented on the large signal response of GaAs laser amplifiers, saturation of gain in a laser amplifier, quenching of the output of a laser oscillator by an applied optical signal, radiation confinement in GaAs lasers, and the operation of a reverse-biased junction as a saturable absorber in the laser cavity of a GaAs laser oscillator. Preliminary results are given on new GaAs laser material in the form of a multilayer structure prepared by vapor-phase epitaxial growth. (auth)

**11852** (AD-839081) SEMICONDUCTOR LASER ARRAYS. Research and Development Technical Report. Wandinger, L.; Klohn, K. L.; Armata, J. F. Jr. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Jul 1968. 21p. (ECOM-2990). NTIS $3.00.

Semiconductor laser arrays are shown to offer a means for increasing the optical power available from injection lasers. This report discusses various methods of fabricating parallel laser array structures which are electrically in parallel and their characteristics. Arrays have been tested in pulse operation at 77°K for their optical power output, threshold current, spectral distribution, linewidth, efficiency and possible interference in the optical output of the laser array. The optical power output of array structures is, aside from inevitable heat losses, the sum of the outputs of the individual diodes. The spectral wavelength was 8404Å, and the linewidth for a double array was 8Å the half-power point. Interference patterns were obtained and no mutual interference between the individual diodes was observed. Photoresist technology is shown to offer an excellent and uncomplicated means of developing large arrays with a very good control on the geometry. (auth)

**11853** (AD-842836) ELECTRON INJECTION LASER. Final Report, 1 January–30 June 1968. Marinace, J. C.; Morehead, F.; Stern, F.; Woodall, J. (IBM Watson Research Center, Yorktown Heights, N. Y. (USA)). Sep 1968. Contract DA-28-043-AMC-02510(E). 68p. NTIS $3.00.

The report covers in detail the work carried out in the fourth and final semiannual period of the contract, and summarizes the work described in the three prior semiannual reports. Epitaxial growth of $Ga_{1-x}Al_xAs$ has been successful over a wide range of values of X, and for junctions and structures with both uniform and graded composition. The electrical, optical, and luminescent properties of the resulting materials have been studied, particularly the external quantum efficiency of electroluminescent junctions as a function of emitted wavelength and Al mole fraction. Lasers have been made by Zn diffusion into epitaxially grown $Ga_{1-x}Al_xAs$. A number of factors in GaAs device technology have been investigated, including contacts, structures, orientation effects, dopant effects, and degradation. Further work has been done on epoxy potting and the properties of epoxies. Implantation of S in GaAs was attempted, but did not give electroluminescent devices. A new scheme for achieving higher and more uniform doping levels in GaAs has been developed. Diffusion of radioactive Zn into a sample doped with radioactive Sn shows that the Sn distribution is perturbed near the diffusion front. (auth)

**11854** (AD-934322) OHMIC CONTACTS FOR GALLIUM ARSENIDE DEVICES. Research and Development Report. Klohn, K. L.; Wandinger, L. (Army Electronics Command, Fort Monmouth, N. J. (USA)). Apr 1968. 17p. (ECOM-2969). NTIS $3.00.

A study was made of various metals and metal alloys (Ag, Ni, In, and Au-Zn) which would make ohmic contacts to p- or n-type GaAs to determine the value of contact resistivity as a function of substrate impurity concentration. The metals were applied by evaporation or plating and followed by microalloying. The improvement in contact resistivity, as substrate impurity concentration increases, indicates the desirability of incorporating a thin, heavily doped region at the surface of a device by means of diffusion or epitaxy. The improvement in power output for a typical laser diode and its modified versions resulting from the reduction in $R_s$ is compared. (auth)

**11855** (CEA-N-1808) DEVELOPMENT OF LASERS IN THE ULTRAVIOLET AND VACUUM ULTRAVIOLET FOR PHOTOCHEMICAL APPLICATIONS. Goujon, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Recherche et Analyse; Paris-11 Univ., 91-Orsay (France)). Jun 1975. 84p. (In French). INIS.

Thesis.

Intense light sources in the ultraviolet ($\lambda > 200$ nm) and in the vacuum ultraviolet ($\lambda < 200$ nm) are valuable in many fields of fundamental and applied research such as spectroscopy, photochemistry or photophysics. Laser emissions in $N_2$, CO, and $H_2$, as well as in $Ar + H_2$ and $Ar + N_2$ mixtures, have been observed in the near ultraviolet and in vacuum ultraviolet. The pulses last 1.5 to 2 ns and the power varies from 1 to 3 MW. These emissions are produced by a transversely excited laser using a travelling wave discharge, the construction of which is described. The performance of such pulsed lasers is discussed as a function of the various parameters involved. The pulse energy was measured either with a photodiode having a known photocathode yield, or by actinometry, measuring the hydrogen formation by photolysis of ethylene ($C_2H_4$). This laser can work recurrently with an excellent pulse reproductibility, thus enabling sampling techniques to be employed. The properties sought after in designing this laser are brevity, and reproducibility of the pulse high power and short wavelengths. It is intended as a fundamental research tool for time-resolved molecular spectroscopy studies. (FR)

**11856** (COM-74-50289) INEXPENSIVE LASER DIODE PULSE GENERATOR FOR OPTICAL WAVEGUIDE STUDIES. Final Report. Andrews, J. R. (National Bureau of Standards, Washington, D. C. (USA)). Jan 1974. 3p. NTIS.

In Rev. Sci. Instrum., 45: No. 1, 22-24(Jan 1974).

An expensive GaAs laser diode pulse generator is presented. This generator has found application in the evaluation of optical pulse dispersion in glass fiber optical waveguide studies. It is capable of producing optical impulses as narrow as 110 ps at a wavelength of 0.9 micrometer and a pulse repetition rate of 50 Hz. With a slight modification, it may be used to produce optical pulses of considerably longer duration at reduced repetition rates. (NTIS)

**11857** (JPRS-46504) SEMICONDUCTOR QUANTUM GENERATOR WITH EXTERNAL RESONATOR. Basov, N. G.; Bogdankevish, O. V.; Pechenov, A. N.; Nasibov, A. S.; Fedoseev, K. P. 24 Sep 1968. Translation of pp 1-16 from Poluprovodnikovii Kvantovii Generator s Vneshnem Rezonatorom, Moscow, 1968. 18p. NTIS $3.00.

Using a semiconductor quantum generator with an active substance in the form of a thin layer with an external resonator permits a considerable increase in the power and an improvement in the directability of the coherent radiation. The dependence of the power and threshold of generation in such a generator based on gallium arsenide during excitation by an electron beam on the diameter of the active region is investigated. (auth)

**11858** (LA-tr-75-42) FREQUENCY TUNABLE LASERS. Kushida, T. Translated from Bunko Kenkyu; 21: No. 2, 67-81 (1972). 19p. Dep. NTIS $3.50.

A review of tunable lasers is presented. The lasers considered include dye lasers, optical parametric oscillators, semiconductor lasers, and Raman lasers. (TFD)

**11859** (N-68-19395) PHOTON-COUPLED ISOLATION SWITCH QUARTERLY REPORT, 1 JULY–30 SEPTEMBER 1967. Bonin, E. L.; Harp, E. E. (Jet Propulsion Lab., Pasadena, Calif. (USA)). 30 Sep 1967. Contract NAS7-100. 20p. (NASA-CR-93668; TI-03-68-14). NTIS $6.00.

The photon-coupled isolation switch is a new type of semiconductor device which uses internal coupling to obtain electrical isolation between the driving source and the output terminals. Internal photon generation and detection techniques are used which combine a gallium arsenide (GaAs) photon emitting diode

with a silicon (Si) phototransistor. A third semiconductor wafer in the isolation switch is a monolithic Si driver circuit for supplying bias to the GaAs diode. The driver circuit uses DTL circuitry to provide up to ten inputs. (NTIS)

**11860** (N-68-21197) GaAs LASER DIODE DIFFUSION INVESTIGATION AND THE ETTINGSHAUSEN LASER THEORY. Haacke, G.; Moench, W. (Allgemeine Elektricitaets-Gesellschaft AEG Telefunken, Frankfurt am Main (F. R. Germany). Fachbereich Kernenergieanlagen). Oct 1967. 74p. (BMWF-FB-W-67-30). NTIS $6.00.

After a review on semiconductor lasers a short introduction to the theory of such lasers is given and the underlying mechanisms of the GaAs p-n junction lasers are discussed. In the experimental part, the results of different diffusion techniques are presented and their influence on the laser properties of GaAs diodes are reported. Using a $ZnAs_2$ Ga source and suitable preparation techniques the threshold for laser emission can be reduced to $10^3$ amp $cm^{-2}$ at 80°K. A new type of semiconductor lasers, the "Ettingshausen laser", is theoretically investigated. The laser condition is satisfied by the deflection of carriers to one side of a homogeneous, current carrying semiconductor specimen via a perpendicular magnetic field. It is shown that such an "Ettingshausen laser" should work in exceedingly pure intrinsic InSb at room temperature at an ExB product of about $10^6$V-G-$cm^{-1}$. (NTIS)

**11861** (N-68-25868) OPTICALLY INDUCED FREE-CARRIER LIGHT MODULATOR. Gruber, C.; Richards, W. E. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Jun 1968. 18p. (NASA-TN-D-4608). NTIS $3.00.

Laser modulators for optical communications systems have recently been the subject of great effort especially in visible or near-infrared regions. The availability of optical sources in these regions, where excellent atmospheric transmission "windows" exist, has prompted attempts to extend the previously developed modulation techniques to longer wavelengths. Existing devices have other disadvantages such as excessive drive power requirements for high-frequency/wide-bandwidth operation, multicomponent optical configurations, inability to modulate at high optical power levels, and (with one or two exceptions) low modulation index. The present paper describes an optical modulation technique that should be able to overcome many of these difficulties and, in addition, provide complete electrical isolation of the modulation element. In addition, the technique can be used over a broad range of infrared wavelengths determined solely by the optical transmission characteristics of the modulator material. In brief, this technique used optically generated free electrons (and/or holes) in a bulk semiconductor in order to change its transmission characteristics. Apart from its construction in suitable semiconducting material, the modulator requires an easily modulated optical pump signal. (NTIS)

**11862** (N-68-30248) RADIATION EFFECTS ON LASERS FINAL REPORT, 1 JULY 1965–OCTOBER 1967. Compton, D. M. (Gulf General Atomic Co., San Diego, Calif. (USA)). 1 Nov 1967. Contract NAS12-32. 80p. (NASA-CR-86068; GA-8238). NTIS $6.00.

A continued program designed to study the effects of space radiation on lasers and to develop the background knowledge needed for the possible application of laser systems in a space environment is reported. The effects of radiation are described for two main types of lasers: gallium arsenide laser diodes, and optically pumped lasers such as ruby and neodymium in various host materials. Results indicate that: (1) neither type of laser is affected by doses and dose rates of space radiation suitable for manned space flight, (2) for more severe environments, e.g., flights spending a large fraction of their time in the trapped radiation belts or with reasonably shielded on-board nuclear power, it is possible to select laser types which will be only minimally affected and whose performance can be restored by an annealing process, and (3) for very severe environments, e.g., near on board nuclear power, it is at least possible to set certain guidelines relating to the effects to be expected. (NTIS)

**11863** (N-70-37034) EXPERIMENTAL INVESTIGATIONS OF STATISTICAL FLUCTUATIONS IN CONTINUOUS-WAVE GALLIUM ARSENIDE LASER DIODES. Guekos, G. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). 1969. 92p. (DISS-4350). NTIS $3.00.

The statistical intensity fluctuations of the laser beam from semiconductor laser junctions and the phenomena associated with these fluctuations is investigated and suitable means to reduce effectively the noise present in the laser light of a given laser diode are found. After a preliminary and simplified discussion of the theory of intensity fluctuations in lasers, the various experiments carried out with cw GaAs laser diodes are discussed. In these diodes, the laser oscillation is not uniform over the whole width of the junction but takes place over a relatively small cross section. Such a region is termed a lasing filament. The experiments show that the filamentary laser action is greatly responsible for the high excess noise level encountered in the laser radiation. This noise is found to be correlated to the laser diode current. This fact represents an important experimental discovery since it is used to eliminate to a large extent the amplitude fluctuations in the laser beam. The Bose Einstein statistical distribution of the photons due to radiation emanating from various thermal sources has been investigated. A single mode He–Ne laser beam is used to measure the intensity fluctuations of the laser beam and a method is presented which leads to a reduction of these fluctuations. (auth)

**11864** (N-70-42768) INVESTIGATION OF A TECHNOLOGICAL PROCEDURE FOR THE FABRICATION OF LASER DIODES. Beneking, H.; Vits, W. (Technische Hochshule Aachen (F. R. Germany). Inst. fuer Halbleitertechnik). Jun 1970. 81p. (In German). (BMBW-FB-W-70-34). NTIS $3.00.

The fabrication of gallium arsenide laser diodes by liquid phase epitaxy is described using phase diagrams. The epitaxy apparatus and process and the preparation of laser diodes are also described. The quality of the epitaxial layers and the planarity of the p-n junctions are shown to depend on substrate orientation and process parameters. The doping profiles and the optical and electrical properties of the diodes are discussed. (NTIS)

**11865** (N-72-24555) TIME-DEPENDENT SPECTROSCOPIC MEASUREMENTS ON A PULSED GaAs LASER DIODE. Vankampen, J. G. May 1971. 14p. (In Dutch and English). (PHL-1971-22; TDCK-58615). NTIS $3.00.

The spectrum of the laser radiation (approximately 0.9 micron) pulsed GaAs diode was determined with sampling techniques as a function of the time at room temperature. From the shift of the spectral modes a rise of junction temperature of 31°K was calculated during the pulse (approximately 200 ns); the mean temperature rises 15°K. (auth)

**11866** (NBS-TN-449) RESEARCH ON LASER STANDARDS AND MATERIALS AT THE NATIONAL BUREAU OF STANDARDS. Kessler, K. G.; Passaglia, E.; Winogradoff, N. N. (National Bureau of Standards, Washington, D. C. (USA)). Jun 1968. 35p. NTIS $6.00.

A brief report is presented on research in the areas of laser standards and laser materials now in progress at the National Bureau of Standards. Included are the measurement of the power and energy output of lasers, their near and far field patterns and their optical properties. The physical and chemical properties of laser materials are studied in an attempt to relate such properties to the operating characteristics of lasers. (auth)

**11867** (NTIS/PS-75/044) GALLIUM ARSENIDE LASERS (A BIBLIOGRAPHY WITH ABSTRACTS). Period Covered: 1964–October 1974. Werner, K. G. (National Technical Information Service, Springfield, Va. (USA)). Jan 1975. 119p. NTIS $25.00.

The bibliography contains 77 selected abstracts concerning the operation and performance of gallium arsenide lasers. Included are abstracts on band theory and solid state research as it directly applies to lasing. (auth)

**11868** (PB-176285) GALLIUM ARSENIDE PHOSPHIDE INJECTION LASER DIODES. Magee, C. J. (Wisconsin Univ., Madison (USA). Engineering Experiment Station). Jan 1967. 114p. NTIS $6.00.

Successful techniques for the laboratory fabrication of $GaAs_{1-x}P_x$ laser diodes have been developed and are discussed in detail. About 100 diodes were constructed by these techniques and electrical and optical measurements were performed. A novel method for determining threshold current that requires only a detector and a polaroid filter was developed during the course of these measurements. It has been found that the depth of the diffused junction formed in the n-type, tellurium doped, starting material is not only dependent upon the temperature and time but also the crystal As:P ratio. Junction planarity was found to depend strongly upon the preparation techniques. Electro and Electroless plating techniques were used to make electrical and thermal contact to the diodes and two low inductance packages were designed to mount them. (auth)

**11869** (UCRL-51931) NUMERICAL INVESTIGATION OF THE PULSED $NF_3+H_2$ CHEMICAL LASER USING A MODEL WHICH INCLUDES ROTATIONAL RELAXATION AND SEMI-CLASSICAL LASER EQUATIONS. Creighton, J. R. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 1 Sep 1975. Contract W-7405-Eng-48. 314p. Dep. NTIS $9.75.

Thesis.

Waveforms and population distributions have been calculated by a numerical model and compared with experiment for an electric-discharge-initiated, pulsed $NF_3 + H_2$ chemical laser. The model treats each vibrational-rotational state separately, allowing rotational relaxation between adjacent states as well as vibrational relaxation and lasing according to P-branch selection rules. Calculated waveforms agree with experiment and show several features not seen when rotational equilibrium is assumed: simultaneous lasing on many transitions, cascade behavior, spikes due to laser relaxation oscillations, non-Boltzmann rotational distributions, and "hole burning" in the population distributions. The calculations give insight into the physical phenomena governing the shape and duration of the waveforms. The effect of varying certain parameters, relaxation rates, temperature, pressure, and diluents, is studied. Best fit to experimental waveforms is obtained when the rotational relaxation rate and collisional line broadening rate are approximately equal at about 10 times the hard sphere collision rate. The IXION computer code, developed for these calculations, is described in detail. In addition, an analytic model is presented which accounts for major features of the total (all transitions) output waveform of the laser assuming rotational equilibrium, a steady state laser model, and constant temperature. A second computer code, MINOTAR, was developed as a general purpose chemical kinetics code. It verifies the analytic model and extends the results to adiabatic reactions where the temperature varies, and can yield waveforms using the assumptions of rotational equilibrium and a steady state laser. The MINOTAR code, being general, can also be used for chemical kinetics problems such as air pollution and combustion. (auth)

**11870** CHARACTERISTICS OF A HIGH-ENERGY HYDROGEN FLUORIDE (HF) LASER INITIATED BY AN INTENSE ELECTRON BEAM. Patterson, E. L.; Gerber, R. A. (Sandia Labs., Albuquerque). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 642-648(Aug 1975).

The characteristics of a high-energy hydrogen fluoride (HF) laser and the effects of optical elements on beam quality and on energy extraction are described. The HF laser is initiated by injecting a 2-MeV electron beam into a mixture of $SF_6$ and $C_2H_6$. With 300-torr $SF_6$ and 30-torr $C_2H_6$, the radiated energy with a flat mirror on one end of the laser cell is approximately equal to 80 percent of the two-way energy when no mirrors are used. The effect of a confocal unstable resonator in providing collimation of the laser beam was studied. The maximum laser energy measured was 380 J in a 23-ns full width at half maximum (FWHM) pulse. The maximum electrical efficiency measured was 14 percent, which is about 60 percent of the maximum theoretical value. (auth)

**11871** $H_2/F_2$ FLAME PROPAGATION AND REPETITIVELY PULSED HYDROGEN FLUORIDE (HF) CHAIN-REACTION CHEMICAL LASER. Chen, H. L.; Daugherty, J. D.; Fyfe, W. (Avco-Everett Research Lab., Inc., Everett, MA). IEEE (Inst. Electr. Electron. Eng.). J. Quant. Electron.; QE-11: No. 8, 648-653(Aug 1975).

The burning velocity and the nature of the $H_2/F_2$ flame at various gas compositions have been experimentally determined. It was found that reactions induced by a diffusion-type flame proceed rather slowly, but reactions triggered by a compression wave proceed with supersonic speed. Based on the measurements of gas stability, repetitive pulse operation of $H_2/F_2$ chemical lasers at atmospheric pressure has been achieved. The second and third explosion limits of $H_2 + F_2$ reactions in $O_2$/He mixtures were also studied experimentally to improve our understanding of the nature of a $H_2 + F_2$ explosion. The apparatus allowed the simultaneous time-resolved measurement of both gas pressure and temperature at the center of the spherical reaction vessel. It was found that, for fixed $H_2 + F_2$ total pressure and $O_2$ concentration, mixtures with higher $F_2/H_2$ ratios are less stable and explode at a lower temperature. It appears quite certain that molecular $O_2$ plays an important role in the chain termination reaction. However, the addition of $CF_4$, $SF_6$, or $N_2$ showed no effect on the boundaries of the $H_2/F_2$ explosion. (auth)

**11872** MEASUREMENT OF VIBRATIONAL-VIBRATIONAL EXCHANGE OF HIGHLY EXCITED STATES OF DIATOMIC MOLECULES WHERE THE COLLISIONAL PROBABILITY IS APPROACHING UNITY. Nachshon, Y.; Coleman, P. D. (Univ. of Illinois, Urbana). IEEE ( Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 654-660(Aug 1975).

An experimental method, employing a fast population perturbation technique, is described to measure the vibrational-vibrational (VV) collisional probability P/sub r,r-1/sup v,v+1/ of a diatomic molecule for large vibrational quantum numbers r and v. The relaxation of the perturbed gain of a pair of vibrational levels is a function of the vibrational populations and VV rate constants k/sub r,r-1/sup v,v+1/. The numerical inversion of the VV master rate equations determining this relaxation does not give unique value for k/sub r,r-1/sup v,v+1/ (or P/sub r,r-1/sup v,v+1), but lower bounds can be evaluated and with empirical formulas, having several adjustable constants, it can be shown that probabilities of the order of unity are required to satisfy the experimental data. The method has been specifically applied to the CO molecule, but other molecules such as HX(X equals F, Cl, Br), NO, etc., could also be measured. (auth)

**11873** MODELING OF THE CW CO CHEMICAL LASER. Lilenfeld, H. V.; Webbink, R. F.; Jeffers, W. Q.; Kelley, J. D. (McDonnell Douglas Research Labs., St. Louis). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 660-669(Aug 1975).

A computer code modeling the $CS_2/O$ cw CO chemical laser is reported. The accuracy of the code has been tested by calculations of small-signal gain, output power, and chemical species densities in devices for which experimental data are available. Generally, good agreement is obtained. The code was also used to predict gain variations with diluent/fuel ratio, initial temperature, and cavity pressure. (auth)

**11874** LASER-EXCITED ELECTRONIC-TO-ELECTRONIC ENERGY TRANSFER IN SODIUM. Chen, H. L.; Fried, S. (Avco Everett Research Lab., Everett, MA). IEEE (Inst. Electro. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 669-672(Aug 1975).

Energy-transfer rates for the E yields E process Na($^2$P/sub 3/2/) + Na ($^2$S/sub 1/2/) reversible Na ($^2$P/sub 1/2/) + Na ($^2$S/sub 1/2/) + DELTA E equals 17.2 $cm^{-1}$ have been measured following direct excitation of specific $^2$P levels with a pulsed tunable dye laser of $10^{-2}$-A linewidth and 5-ns duration. The cross sections for the forward and backward reactions at 272$^0$C have been found by Pitre and Krause to be 250 +- 40 and 480 +- 80 A, respectively. (auth)

**11875** DF-$CO_2$ TRANSFER LASER DEVELOPMENT. Tregay, G. W.; Drexhage, M. G.; Wood, L. M.; Andrysiak, S. J. (Textron Bell Aerospace, Buffalo). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 672-678(Aug 1975).

Power extraction and chemiluminescence experiments have been conducted in the large-scale DF-$CO_2$ transfer chemical laser (TCL) (IRIS-I and IRIS-II) facility at Bell Aerospace Company (BAC). The modular design of the device allowed testing to be conducted with both a supersonic nozzle bank and also in subsonic flow with sonic injection for the deuterium. Power levels of 15 kW at 10.6 mu were obtained in IRIS-I (subsonic) employing an unstable resonator with a 50 percent output coupling ratio and cavity pressure of 35 torr. For IRIS-II (supersonic) somewhat lower power was obtained. In both systems the fluorine dissociation (alpha equals $F/F + 2F_2$) was less than 0.01. Chemiluminescent emission from HF and DF was monitored under zero-power conditions along an axis parallel to the laser-mirror axis. From the measured DF-concentration profiles it can be inferred that vibrationally excited DF is being produced throughout the cavity and, accordingly, the production of DF must be attributed largely to the chain reaction. (auth)

**11876** INTERMOLECULAR VIBRATION-TO-VIBRATION ENERGY TRANSFER IN HF/DF(nu equals 1) + HF/DF(nu equals 1) yields HF/DF(nu equals 0) + HF/DF(nu equals 2) THROUGH THE FORMATION OF DIMERS. Shin, H. K. (Univ. of Nevada, Reno). IEEE (Inst. Electr. Electron. Eng.) J. Quant. Electron.; QE-11: No. 8, 679-684(Aug 1975).

A theory of vibration-to-vibration energy transfer is developed for HF/DF(nu equals 1) + HF/DF(nu equals 1) yields HF/DF(nu equals 0) + HF/DF(nu equals 2) based on the model of dimer formation. This model is shown to be primarily responsible for the energy transfer below 500$^0$K where a strong negative temperature dependence of energy-transfer rates is found; above this temperature the rapid rotational motion of the colliding molecules causes the energy exchange to take place with the result that the rate increases with temperature in a normal fashion. The model represents the low-temperature limit of the energy-transfer process, while the rapid rotational model gives the high-temperature limiting rate, so the overall collision process can be explained in terms of these two contributions. The sum takes a minimum value near 700$^0$K in both HF + HF and DF + DF collisions. (auth)

**11877** LASER INDUCED DAMAGE IN OPTICAL MATERIALS: 6TH ASTM SYMPOSIUM. Glass, A. J.; Guenther, A. H. (Lawrence Livermore Lab., CA). Appl. Opt.; 14: No. 3, 698-715(Mar 1975).

From 6th ASTM symposium; Boulder, CO (Mar 1975).

The Sixth ASTM-ONR-NBS Symposium on Laser Induced Damage in Optical Materials was held at the National Bureau of Standards in Boulder, Colorado on 22-23 May 1974. Over 150 attendees at the Symposium heard thirty-one papers on topics relating to laser induced damage in crystalline and nonlinear optical materials, at dielectric surfaces, and in thin film coatings as well as discussions of damage problems in the ir region due

both to cw and pulsed irradiation. In addition, several reports on the theoretical analysis of laser-materials interaction relative to the damage progress were given, along with tabulations of fundamental materials properties of importance in evaluation of optical material response to high-power laser radiation. Attention was given to high-power laser system design considerations that relate to improved system performance and reliability when various damage mechanisms are operable in such systems. A workshop on the machining of optics was held, and nine papers on various facets of the topic were presented dealing with machining procedures, surface characterization of machined elements, coating of machined components, and the polishing and damage resistance of polished, coated, and bare metal reflectors. (auth)

**11878** HYDROGEN ENERGY. Part B. Hydrogen Economy Miami Energy Conference, Miama Beach, Florida, March 18–20, 1974. Veziroglu, T. N. (ed.). New York; Plenum Publishing Corporation (1975). 719p. (CONF-740306–PB).

Forty-five papers presented at the THEME Conference have been abstracted separately. Three items have been announced in both Nuclear Science Abstracts and ERDA Energy Research Abstracts, and forty-two have been announced in ERDA Energy Research Abstracts. (LK)

*For abstracts of individual papers see: 11879, 12068, and 13964.*

**11879** HYDROGEN FUELED GAS DYNAMIC LASER. Cavalleri, R. J. (Atlantic Research Corp., Alexandria, VA). pp 677–684 of Hydrogen Energy. Part B. Veziroglu, T. N. (ed.). New York; Plenum Publishing Corp. (1975).

From hydrogen economy Miami energy conference; Miami, Beach, Florida, USA (18 Mar 1974). See CONF-740306-PB.

The physics behind a conventional $CO_2$ Gas Dynamic Laser are briefly described. Recent improvements in GDL technology have shown a possible threefold improvement for $CO_2$ GDL's. The extension of this technology to a hydrogen fueled laser is discussed. The preliminary indications are that for a hydrogen laser, an order of magnitude improvement is possible. (auth)

**11880** SOLID STATE PULSER USING PARALLEL STORAGE CAPACITORS. Amberger, D. J.; Celentano, R. A. (to United States Office of the Secretary of the Army). US Patent 367,8362. 18 Jul 1972. Filed date 17 Sep 1970. 4p.

A solid state pulse generator that produces high current narrow pulses and includes a bank of parallel silicon controlled rectifier-capacitor combinations, designed for driving a GaAs diode laser is described. A trigger circuit is connected to all the gate circuits of the silicon controlled rectifiers, through separate adjustable resistors. The adjustable resistors make it possible to simultaneously fire the silicon controlled rectifiers with a single trigger pulse. (NTIS)

**11881** LASER WITH A VARIABLE SPECTRAL INTERVAL BETWEEN THE LINES OF OSCILLATION. Nestrizhenko, Yu. A.; Pyatikop, A. P. Kvantovaya Elektron. (Kiev); 8: 124-126(1974). (In Russian)

A neodymium glass laser was experimentally investigated in which the spectral interval between the lines of oscillation varies with the aid of a tuned interference polarized filter. For tuning the filter the dependence of the refractive index of an extraordinary beam in a crystal plate on direction of propagation was used. It was shown that a change in the angle between the optical axis and the normal to the wave by tens of degrees leads to a change in the spectral interval by orders of magnitude that is sufficient for solving many problems associated with obtaining total and difference frequencies. (auth)

**11882** INVESTIGATION OF MICROSECOND PULSE LASER GENERATION WITH NON-LINEAR ABSORBERS. Baltramiejunas, R.; Vaitkus, J.; Veleckas, D. Liet. Fiz. Rinkinys; 14: No. 2, 335-343(1974). (In Russian)

The basic properties of the neodymium-glass and ruby lasers with the tunable laser pulse duration were investigated. The increase of the laser pulse was achieved by inserting crystals of the non-linear semiconductors CdS, CdSe, and GaAs in the cavity. The duration of the laser pulse varied from 30 to 2500 ns. The experimental results show that fast Q-switching leads to a non-stationary regime of laser generation when the non-linear absorber is used. If slow Q-switching is used power limitation in the cavity occurs. In this case the duration of the laser pulse is determined by the speed of the rotating prism and by the threshold of the laser generation. (Electr. Electron. Abstr.)

**11883** ENERGY CHARACTERISTICS OF A CHEMICAL HF LASER INDUCED BY AN ELECTRON BEAM. Ponomarenko, A. G.; Soloukhin, R. I.; Khapov, Yu. I. (Inst. of Theoretical and Applied Mechanics, Novosibirsk, USSR). Dokl. Akad. Nauk SSSR; 221: No. 4, 821-824(1 Apr 1975). (In Russian).

Using a mixture of $H_2$ + $SF_6$ (ratio varying from 1:30 to 1:7) and with pressures from 0.1 to 2 atm, a chemical reaction was initiated by an accelerator electron beam (maximum energy 100 to 120 keV). The general shape of the dependence of the total radiation energy on the pressure was the same over a wide range of $H_2$:$SF_6$ ratios. With increasing pressure, the radiation energy increased, reaching a maximum at an optimum pressure, and then dropped. The results showed that in a chemical HF laser with an $H_2$ + $SF_6$ mixture at pressures of 1 atm or more it is not permissible to neglect collisional deactivation of the activated HF molecules by H molecules since this decreases the coefficient of intensification and thus the emf of the laser. A high coefficient of intensification makes it possible to operate with a single mirror. With proper selection of conditions the optimum pressure is 0.8 atm. The optimum ratio of the components is between 1:15 and 1:7. (TTT)

**11884** COMPACT NEON–HELIUM LASER WITH HIGH POWER. Bazylenko, V. A.; Gryazev, A. A.; Krindach, D. P. Prib. Tekh. Eksp.; No. 3, 206-208(1975). (In Russian).

The laser described is of higher power than the usual He–Ne device with a wavelength of 0.63 $\mu$ with smaller dimensions. For the effective suppression of wavelengths at 3.39 $\mu$, required for low losses in the laser's resonator, a system of rotating mirrors is used. A diagram of the mirrors and their placement relative to the gas-discharge tubes in the laser is shown. Experiments performed with the laser are described, and a table is given of the power levels generated with various resonator configurations. (JPRS)

**11885** TUNABLE INFRARED SEMICONDUCTOR LASERS. Jedrzejczak, A. (Inst. of Physics, Warsaw). Postepy Fiz.; 26: No. 1, 17-31(1975). (In Polish).

Progress in the field of device fabrication, the composition, magnetic field, pressure and temperature tuning, and applications of infrared semiconductor lasers is reviewed. (auth)

**11886** HOW TO MAKE AN X-RAY LASER. Ferguson, A. (Saint Andrews Univ., Eng.). New Sci.; 68: 207-209(23 Oct 1975).

An exciting feature of the x-ray laser is that its development could greatly extend our knowledge of the structure of biological macromolecules. The problem in building x-ray lasers lies in the difficulty in creating a population inversion on a closed shell transition. Several schemes to demonstrate x-ray lasing which have appeared recently in the literature are considered. These include methods which involve the removal of electrons from the inner electron shells in atoms, those which involve a highly ionized plasma, those using ion beams, and a method of laser frequency conversion where laser light incident on some medium is coherently scattered giving light at a changed frequency. (UK)

**11887** EFFECT OF LOCATION OF OUTLET MIRROR, PLACED INSIDE THE RESONATOR, ON THE NATURE OF THE SELF-MODULATION OF THE MONOPULSE IN A LASER. Milinkevich, A. V.; Savva, V. A.; Samson, A. M. Zh. Prikl. Spektrosk.; 22: No. 6, 997-1001(Jun 1975). (In Russian)

The self-modulation of gigantic pulses was studied theoretically in a laser with a three-mirror resonator with rapid single inclusion of figure of merit. The nature of the self-modulation depended on the location of the units (mirror, shutter) in the resonator. From four to one pulse at the by-pass was observed. A similar analysis is easily made for lasers with resonators of a more complex configuration. (tr-auth)

**11888** TWO-SECTION LASERS ON SOLUTIONS OF RHODAMINES AND OF EUROPIUM CHELATES. Malashkevich, G. E.; Kuznetsova, V. V.; Khomenko, V. S. Zh. Prikl. Spektrosk.; 22: No. 6, 1006-1008(Jun 1975). (In Russian)

A study was made of the generation, with lamp pumping, of a liquid laser on alcohol solutions of rhodamine C and $Eu(TTA)_4HP$ poured into separate sections of special two-section cuvettes. The possibility of stabilizing the generation bands in the region of the rare earth ion luminescence and the obtaining of multiwave generation was observed. (tr-auth)

**11889** CRYSTAL REFLECTORS AS SELECTIVE MIRRORS FOR LASERS IN THE INFRARED REGION. Leshenyuk, N. S.; Orlov, L. N.; Shevchenko, S. S. Zh. Prikl. Spektrosk.; 22: No. 6, 1016-1019(Jun 1975). (In Russian)

The possibility was considered of using crystals reflecting in the characteristic absorption band as selective mirrors for lasers in the infrared region. The properties of $CO_2$ lasers were studied when $SiO_2$ or SiC was used as one of the resonator mirrors. (tr-auth)

**11890** STUDY OF THE AMPLIFICATION AND LASING CHARACTERISTICS OF A XENON–HELIUM LASER OPERATING

AT $\lambda = 3.51$ μm. Tsar'kov, V. A. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 20: No. 1, 90-92(Jan 1975).

Translated from Radiotekh. Elektron.; 20: No. 1, 138-142 (Jan 1975).

The dependence of the unsaturated gain and the lasing power of a xenon-helium laser, operating at a wavelength of $\lambda = 3.51$ μm, on the pressure of the gas mixture, the ratio of the Xe and He partial pressures, the discharge current and the cell diameter is investigated. The maximum gain, obtained in a 1-mm diameter cell, is 425 dB/m. (auth)

**11891** OPTICAL DIAGRAM OF MONOPULSED RUBIDIUM LASER WITH A HIGH RADIATION POWER. Matyushkov, V. E.; Mikhnov, S. A. Zh. Prikl. Spektrosk.; 23: No. 1, 155-157(Jul 1975). (In Russian)

Construction features of a monopulsed rubidium laser with a radiation power up to 100 MW are presented. Tests on this laser with passive shut-off device showed a high reliability of the generator and stability of its energy parameters. (tr-auth)

**11892** PLASMA LASERS IN BINARY MIXTURES WITH CONSIDERATION OF RECHARGING. Reshtnyak, S. S.; Shelepin, L. A. Zh. Prikl. Spektrosk.; 23: No. 1, 35-41(Jul 1975). (In Russian)

The possibility of using a plasma containing a mixture of elements as an operating laser medium is discussed. Quasi-stationary analytical functions for distribution of the population of the energy levels in a plasma consisting of two elements with consideration of recharging were obtained. Based on these functions, the distribution of the kinetics of physical processes in a selenium-helium laser was studied and the basic experimental dependences explained. (tr-auth)

**11893** ZEEMAN RING LASER IN A REGIME OF GENERATION OF DIFFERENT TYPES OF OSCILLATIONS IN OPPOSITE DIRECTIONS. Sardyko, V. I. Zh. Prikl. Spektrosk.; 23: No. 1, 47-53(Jul 1975). (In Russian)

The placement of a longitudinal or transverse magnetic field on the active medium and inside a resonator of the corresponding selector makes possible a specific-frequency regime of operation with noncoincidence of a circular laser in which generation is accomplished in $TEM_{00q}$ modes with noncoincidence for the opposite directions with indexes q. This regime is analyzed theoretically and its experimental operation described. The required operating regime of a helium-neon circular laser with the use of a longitudinal Zeeman effect was shown to be rather simple and easily reproduced and maintained over a wide range of changes in the magnetic field (100 to 250 Oersteds). (tr-auth)

**11894** YAG:Nd PUMPING BY A PLANAR AlAs HETEROJUNCTION LIGHT-EMITTING DIODE. Alferov, Zh. I.; Andreev, V. M.; Garbuzov, D. Z.; Davidyuk, N. Yu.; Larionov, V. R.; Pashinin, P. P.; Prokhorov, A. M.; Rumyantsev, V. D.; Tuchkevich, V. M.; Khaleev, M. M. (Ioffe Physicotechnical Inst., Leningrad). Sov. Phys.-Tech. Phys. (Engl. Transl.); 20: No. 2, 231-233(1975).

Translated from Zh. Tekh. Fiz.; 45: No. 2, 368-373(Feb 1975).

Experiments on the use of AlAs–GaAs heterojunction light-emitting diodes to pump neodymium-activated yttrium aluminum garnet are reported. In this laser system the planar diodes are placed in the immediate vicinity of the lateral surface of the garnet rod, in the gaps of a cylindrical reflector filled with an immersion liquid with a refractive index $n = 1.65$. The calculated pumping coefficient is compared with the results of experiments carried out to determine the threshold power. (auth)

**11895** LASER WINDOW MATERIALS: AN OVERVIEW. Deutsch, T. F. J. Electron. Mater.; 4: No. 4, 663-719(Aug 1975).

The laser window problem is reviewed with emphasis on failure mechanisms, absorption processes, and material evaluation. Failure by thermal fracture and by optical distortion is discussed and the material parameters needed to calculate figures of merit for these failure modes are tabulated for a variety of materials. The exponential dependence of absorption coefficient on wavenumber for intrinsic multiphonon processes is discussed and its use in discriminating extrinsic from intrinsic absorption emphasized. Laser calorimeter absorption measurements at 10.6 and 5.25 mu m are described and the measured values tabulated. The use of internal reflection spectroscopy to examine the effect of various surface treatments on surface absorption is discussed. The absorption of most KCl crystals at 10.6 mu m is shown to be impurity dominated. (Metals Abstr.)

**11896** STRONG SIGNAL LASER THEORY. Hambenne, J. B. Tucson, AZ; Univ. of Arizona (1975). 165p. University Microfilms Order No. 75-22,382.

Thesis (Ph. D.).

A Lamb semiclassical theory is developed for multimode, mode locked laser operation. The equality of frequency spacings between adjacent modes causes population pulsations generated in the nonlinear atomic response to be integer multiples of the adjacent mode spacing. This allows the atomic response to be written in terms of Fourier series, thereby reducing coupled differential equations of motion to algebraic equations ultimately expressible in terms of a continued fraction. A unidirectional ring configuration is assumed so that the more complicated spatial dependence of standing waves is avoided. Reductions are made to the rate equation limit and to the special two-mode cases of bidirectional-ring operation and single-mode, standing-wave, gas laser operation. A two-mode stability analysis yields strong-signal counterparts to the coupling parameter. Two-mode homogeneous broadened operation leads to the discussion of population inversion gratings and associated Bragg scattering. Symmetry properties of the equations for the bidirectional ring are examined. Methods of numerical analysis are outlined and results for Doppler broadened two-mode special cases and the three-mode locked unidirectional-ring operation are presented. The strong-signal results are compared to those of the third-order and REA theories. For the bidirectional ring the historical third-order domain of relative excitation from 1.0 to 1.2 is divided into a valid third-order region and a less accurate region. The condition of bistable operation versus monostable operation is seen to be dependent on the relative excitation and the amount of homogeneous broadening. Two types of bistable operation are seen to exist, one where one mode is completely suppressed and another where both modes may have non-zero intensities. (Diss. Abstr. Int., B)

**11897** CALCULATION OF LASER INTENSITY FLUCTUATIONS FROM THE DENSITY-MATRIX EQUATION OF MOTION. Smith, W. A. (City Coll., New York). Phys. Rev., A; 11: No. 6, 2025-2035(Jun 1975).

Intensity fluctuations for a single-mode laser near threshold are calculated from the Scully–Lamb equation of motion for the reduced density matrix of the radiation field. The magnitude and correlation time of the intensity fluctuations are contrasted with the results obtained from the usual Fokker–Planck analysis of the rotating-wave, Van-der-Pol (RWVP) model. When the photon number at threshold is not large, these calculations predict measurable differences from the RWVP Fokker-Planck results. Two methods are used to calculate the dynamics. One is a direct eigenfunction expansion of the Green's function of the equation of motion. The other is based on the calculation of the initial derivatives of the correlation function. (auth)

## Cryogenic and Superconducting Equipment and Devices

*Refer also to abstracts 11707, 12744, and 12745.*

**11898** (ERDA-tr-79) APPLICATIONS OF SUPERCONDUCTING MAGNETS. Part 1. Karlsruhe, W. H. Translated from Phys. Bl.; No. 5, 197-207(1949). 13p. Dep. NTIS $4.50.

The theory, construction, and operation of superconducting magnets are reviewed. The uses of superconducting magnets are discussed under the following topics: high field research; superconducting magnets in the middle field range as economic alternatives; detection magnets; beam guidance magnets; pulsed superconducting magnets; superconducting shield magnet; and magnets with great field constancy. (TFD)

**11899** (ERDA-tr-81) SUPERCONDUCTING INDUCTIVE ENERGY STORAGE SYSTEMS. Heinz, W.; Komarek, P. 1974. Translation of pp 103-107 of VDI Report No. 223. 10p. Dep. NTIS $4.50.

Superconducting magnetic systems store energy with high density. They could therefore be applied both as a fast dischargeable pulse storage system for high momentary power flux as well as a slow dischargeable large storage system. Whereas use as a high current pulse source appears promising with plasma physics experiments and with the future fusion reactor, the technical feasibility and economic viability of a superconducting large storage system with an energy content of a number of GWh must still be considered as uncertain. After a few main considerations, superconducting energy storage systems as current pulse generators and for use in the grid are discussed. The outlook of possible parameters and technical problems of larger plants are given. Finally, a report is given concerning experiments with energy storage systems in the 100 kWs range and the future prospects provided on possible parameters and technical problems of larger installations. (auth)

**11900** (ERDA-tr-82) PROBLEMS OF COOLING SUPERCONDUCTING SYNCHROGENERATORS. Hofmann, A. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Experimentelle Kernphysik; Kernforschungszentrum Karlsruhe (F.R. Germany)). Mar 1975. Translation of a German Report. (CONF-750359-2). 8p. Dep. NTIS $4.50.

From spring meeting of the solid-state physicists of the DPG; Muenster, F.R. Germany (17 Mar 1975).

The development of large turbogenerators with superconducting exciter winding has moved into the area of considerable economic interest. The advantages and problems of superconductance are discussed. The problems of cooling the cold rotor are especially considered in detail. At the same time, discussions concern what thermal losses are to be expected and what effects occur with respect to coolant flow, heat transmission as well as the change of state of coolant in a rotating system as a result of centrifugal and Coriolis forces. A listing is made as to what formulations are available for solution of these problems and what investigations are to be carried out before a reliable design of a superconducting rotor can result. (auth)

**11901** (ERDA-tr-85) CURRENT TRANSFORMATION AND FIELD SCREENING WITH SUPERCONDUCTING COILS. Scherer, M.; Turowski, P. Translation of KFK-2064 24p. Dep. NTIS $3.50.

Investigations on the inductive generation of electrical currents in superconducting coils are reported. The induced currents are limited by the I/sub c/, B curve of the superconductor so that they break down at certain values of magnetic field. After each breakdown, a current is induced again if the field increases continuously. From an examination of the current field values at the breakdown points, the I/sub c/, B curve for the superconducting material can be derived. As a maximum, currents of 4000 A were induced in a coil made of superconducting cable. Inductive screening of a magnetic field by a superconducting coil is correlated with a negative field in the center. (auth)

**11902** (LA-UR-75-2199) QUANTITATIVE STUDIES OF MAGNETIC COOLING ON A MAGNETIC SYSTEM WHICH OBEYS THE THIRD LAW. Johnson, J. D.; Bonner, J. C. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-eng-36. 9p. (CONF-751209-10). Dep. NTIS $4.50.

From 21st annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

Quantitative estimates of magnetic cooling in ferro-(para-) and antiferromagnets have not been feasible in the past because the standard theoretical models and approaches all disobey the third law of thermodynamics and are consequently unreliable at low temperatures. Recently, an essentially exact treatment has been developed for the linear anisotropic Heisenberg-Ising chain, the only solvable model which does obey the third law. Novel and complex features in the cooling behavior of the antiferromagnet are observed, and arguments are presented to indicate that quasi-(1-D) magnetic systems may turn out to be serious rivals to the classic cooling paramagnets like CMN. (auth)

**11903** CALCULATING THE CONFIGURATION OF THE WINDINGS OF SUPERCONDUCTING MAGNETS. Zhukov, B. N.; Lebedev, V. N.; Mozalevskii, I. A. (Scientific-Research Inst. of Electrophysical Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 365-367(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 37-40(1975).

A method is described for calculating the configuration of ideal windings with a constant current density and practical windings made of discretely positioned conductors which create a stipulated field distribution inside an arbitrarily shaped aperture for magnets with or without an iron shield. The results of calculations for magnets and lenses of superconducting synchrotrons for an accelerator-storage aggregate are presented. (auth)

**11904** PROPOSED DESIGNS FOR SUPERCONDUCTING LENSES FOR HIGH VOLTAGE ELECTRON MICROSCOPES. Bonjour, P. (Paris Univ., Orsay, France). J. Phys., E (London); 8: No. 9, 761-763(Sep 1975).

New shapes for high field, superconducting lenses, are computed from Poisson's equation, taking into account the strong saturation of the magnetic circuit. The optical properties of these lenses are better than those of lenses of classical design working in the same conditions. (auth)

**11905** HIGH FIELD SUPERCONDUCTING ELECTRON LENSES WITH HOLMIUM POLE-PIECES. Bonjour, P. (Paris Univ., Orsay, France). J. Phys., E (London); 8: No. 9, 764-768(Sep 1975).

A superconducting lens with holmium polepieces is described and the measured optical properties of this lens for various excitations and several gap values are presented. An objective focal length of 7.5 mm and a projector focal length of 9.5 mm can be achieved at 3 MV. The aberration coefficients are also smaller than those of classical lenses operating with the same accelerating voltage. A limit of resolution of 1 Å can be expected. (auth)

**11906** RECENT ADVANCES IN THERMOMETRY BELOW 0.1 K. Parker, D. S.; Corruccini, L. R. (Univ. of California, Davis). Cryogenics; 15: No. 9, 499-507(Sep 1975).

A brief description of the more important new techniques in very low temperature thermometry is presented. Advantages and disadvantages of the various thermometers are discussed, and a set of more complete references provided. (auth)

**11907** $^3$He CRYOSTAT-LIQUEFIER WITH MECHANICAL PRECOOLING. Lerner, E.; Daunt, J. G. (Stevens Inst. of Tech., Hoboken, NJ). Cryogenics; 15: No. 9, 548-550(Sep 1975).

This note describes a cryostat for maintaining temperatures below 1°K, which does not require liquid $^4$He transfer from external vessels. The system has applications where ultra-low temperatures are required and in which the periodic provision of externally supplied cryogenic liquids is either not possible or not desirable. By use of three refrigerative sub-systems operating in cascade, the cryostat can maintain temperatures down to 0.25°K using pure liquid $^3$He as the third and final sub-system. Liquid $^4$He, used as precoolant for the $^3$He is liquefied inside the cryostat by means of a Joule-Thomson (J-T) circuit which constitutes the second sub-system. The necessary precooling for the $^4$He J-T circuit is produced by means of a mechanical refrigerator, capable of producing temperatures down to about 12°K, which constitutes the first sub-system. (UK)

**11908** INDUCED CIRCUMFERENTIAL CURRENTS AND LOSSES IN FLEXIBLE SUPERCONDUCTING CABLES. Sutton, J. (Central Electricity Research Labs., Leatherhead, Eng.). Cryogenics; 15: No. 9, 541-545(Sep 1975).

In most designs for flexible ac superconducting cables each phase is carried by a co-axial pair of conductor tubes formed from a single layer of helically laid conductor strands. It is shown that the cable current would generate a net axial magnetic flux and hence an alternating circumferential electric field outside each co-axial pair. If, as in some cable designs, each conductor pair is to be contained in its own helium pipe, circumferential currents will be induced in the pipe wall. The losses depend on the pipe material but are typically three orders of magnitude too large. One solution is to line the pipe with superconductor, such as lead, but this could require more niobium in the conductor itself. Alternatively, the co-axial pair could be redesigned so that there is no net axial flux. One possibility is to form conductor tubes from two layers of conductor strands laid in helices of opposite sense. The induced current problem is avoided if all three phase conductors are contained in a common helium pipe, provided that there are no zero sequence components to the phase currents. Losses from any zero sequence component could be readily reduced to an acceptable level, for example by laying a ferromagnetic strip alongside the conductors inside the helium pipe. Since circulating currents will also be induced in the electrostatic screens adjacent to the conductor strands the screens must be of semiconducting rather than metallic tape. (auth)

**11909** SUPERCONDUCTING COIL INDIRECTLY COOLED BY FORCED HELIUM FLOW. Ogata, H. (Hitachi Ltd., Ibaraki, Japan); Sata, S.; Kimura, H.; Tomeoku, H. Cryogenics; 15: No. 8, 474-478(Aug 1975).

A small superconducting coil is indirectly cooled by a forced flow of helium. The coil, wound from Nb-Ti-Zr multifilament superconducting composite, is 15 mm ID, 24 mm OD and 30 mm long. The maximum central field is 30.3 kG at 4.2°K. Contact between the cooling tube and the coil is achieved using grease. The experimental results are expressed by a relation of critical current and energizing rate. Typical transient temperatures of the coil and coolant during energizing and after quenching are presented. The analysis shows the design of coils of this type is possible using hysteresis loss and heat conduction analysis. (auth)

**11910** MILLIMETER-WAVE CONVERSION AT SUPERCONDUCTING POINT CONTRACTS USING INTRINSIC JOSEPHSON OSCILLATION. Avakyan, R. S.; Vystavkin, A. N.; Gubankov, V. N.; Shtykov, V. D. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 20: No. 1, 153-155(Jan 1975).

Translated from Radiotekh. Elektron.; 20: No. 1, 216-218 (Jan 1975).

The possibilities of using the Josephson effect in weakly coupled superconductors for the parametric conversion of weak varying signals have been investigated in a number of theoretical and experimental papers. The purpose of the work was to investigate experimentally the down-conversion of millimeter-wave signals at superconducting point contacts using the intrinsic Josephson oscillation as the pump signal. On the basis of measurement results the fluctuation sensitivity of these converters has been estimated and a comparison is made with the other theory. (TFD)

**11911** INVESTIGATION OF $CO_2$ LASERS FOR FUSION RESEARCH. Mosavi, R. K. Cincinnati; Univ. of Cincinnati (1975). 117p. University Microfilms Order No. 75-16,856.

Thesis (Ph. D.).

Electrical discharges in $CO_2$, $N_2$, and He mixtures at atmospheric pressure, as a means of laser pumping, are investigated.

Ultraviolet (uv) radiation is employed to initiate and stabilize these high-pressure gas discharges in a large-volume cavity (100 cm × 10 cm × 5 cm). A low-ionization-gas, Tri-n-propylamine ($[CH_3(CH_2)_2]_3N$), is used to seed the laser gas mixtures. Significant increase in the duration of stable diffuse discharge plasma is achieved by uv preionization of the seeded gas mixtures. Stable discharges as long as 5 microseconds with peak current densities of 2.5 A/cm$^2$ are produced. Increasing the current in the plasma decreases the period of stability to 2 microseconds, at which time stability is no longer a sensitive function of current. Stable discharges with high current (peak densities of 5 to 15 A/cm$^2$) and low sustaining electric field (5 kV/cm-atm) for a duration of 2 microseconds are achieved. A photon mean free path greater than 25 cm at atmospheric pressure is observed. A possible mechanism of uv interaction with laser gas mixture at high pressure, a theoretical model of laser radiation interaction with the amplifying medium, and an explanation of the enhancement of discharge plasma stability due to the presence of low-ionization seeding gas are presented. The effect of circuit parameters, different gas mixtures, and preionizer distance from the cavity axis are discussed. A significant population inversion is demonstrated by the gain measurements. (Diss. Abstr. Int., B)

**11912** NIOBIUM–TIN CABLES: HIGH-PERFORMANCE SUPERCONDUCTORS. Cryog. Ind. Gases; 10: 16-17(Aug 1975).

The development of a highly flexible Nb–Sn superconducting cable is discussed. The cable is available in diameters from 0.4 to 2 mm, capable of carrying currents ranging from 90 to 1500 A, respectively, in fields of 50,000 G. (TFD)

**11913** SMALL, LOW INTERNAL VOLUME VALVE: AND A LOW TEMPERATURE BELLOWS-SEALED NEEDLE VALVE. Oversluizen, T. (Brookhaven National Lab., Upton, NY). Rev. Sci. Instrum.; 46: No. 6, 788-789(Jun 1975).

Two valves are described: (1) a small regulating valve with an internal volume of 0.24 cm$^3$ which uses some commercially available parts and is used in high pressure $^3$He gas handling systems, and (2) a high pressure bellows-sealed valve for low temperature applications, including superfluid $^4$He. (auth)

**11914** EXPERIMENTAL SET-UP FOR ULTRA-LOW TEMPERATURES. Avenel, O.; Coustham, J.; Flouquet, J.; Laurencon, J.; Roubeau, P.; Varoquaux, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique; Paris-11 Univ., 91–Orsay (France). Inst. d'Electronique Fondamentale; Paris-11 Univ., 91–Orsay (France). Lab. de Physique des Solides). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 15, 467-470(21 Apr 1975). (In French).

An ultra-low temperature set-up is described with which the pressures and temperatures of the remarkable points of the solidification curve of $^3$He were measured. Point C occurs at a pressure of 34399.8 mB, i.e. 51.5 mB higher than point A, and at a temperature of 1,08 mK measured by NMR. (FR)

## Heat Transfer and Fluid Flow

*Refer also to abstracts 11785, 14032, 14033, 14159, and 14162.*

**11915** (ANL-Trans-994) HEAT TRANSFER CRISIS IN AN INDIVIDUAL EVAPORATION CHANNEL. Doroshchuk, V. E.; Lantsman, F. P.; Levitan, L. L.; Nigmatulin, B. I. Sep 1975. Translated from pp 27-44 of Heat Transfer Crisis During Heating in Channels, Obninsk, USSR, 1974. 13p. Dep. NTIS $4.50.

Experiments performed to study the heat transfer crisis, or dryout, of steam-water flow in heated tubes and annuli are described. (LCL)

**11916** (EUR-5309e, pp vp Paper SNI 2/17) VISUALIZATION OF THE BOILING PHENOMENA ACCOMPANYING THE DIRECT CONTACT OF A HOT LIQUID WITH A COLD LIQUID. Costa, J.; Fabrega, S.; Flamand, J. C. (CEN, Grenoble, France). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra–Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

An experimental program was started to study the transient boiling phenomena accompanying the direct contact of a hot liquid, e.g. oil, with a cold liquid, e.g. water. One of the objectives was to test the hypothesis of vapor explosions that could happen before fragmentation of the hot material. (auth)

**11917** (JAERI-M-5969) METHOD OF CHARACTERISTICS FOR AXI-SYMMETRIC TWO-DIMENSIONAL FLOWS. Kobayashi, K.; Namatame, K. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 13p. INIS.

By applying the method of characteristics to the axi-symmetric two-dimensional mass, momentum and energy conservation laws, a set of bicharacteristic curves and compatibility conditions equivalent to them is obtained. A numerical integration method for the compatibility conditions along the bicharacteristic curves is also described. (auth)

**11918** REMARKS ON TEMPERATURE MEASUREMENTS IN FLUID FLOW. Semeria, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Transferts Thermiques). pp 89-116 of Techniques de mesure dans les ecoulements. Paris; Eyrolles (1974). (In French).

From summer school of fluid mechanics. Measuring methods in fluid flow; Ermenonville, France (24 Sep 1973).

The ambiguity of the concept of flow temperature is shown and the conventional definition of mixture temperature to be attained from the indication of a probe is thus obtained. The discrepancies between the probe temperature and mean temperature may be due either to the flow itself (temperature gradients in the flow) or to the flow perturbation by the probe. The conduction effects of the probe holder, thermal radiation and probe heating in high velocity flow are successively examined. The problem of the response time determination is then examined by showing the importance of the existing transient hydrodynamic effects. Some fundamental books on temperature measurement are indicated in the bibliography. (FR)

**11919** MEASURING METHODS IN TWO-PHASE FLOW. Delhaye, J. M. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Service des Transferts Thermiques). pp 471-531 of Techniques de mesure dans les ecoulements. Paris; Eyrolles (1974). (In French).

From summer school of fluid mechanics. Measuring methods in fluid flow; Ermenonville, France (24 Sep 1973).

In view of measuring the void fraction of phase on a segment or in a section, mean velocity of the liquid phase in a section, real titration, total mass flow rate, local void fraction, local velocity of the liquid, and local temperature of each phase, the following methods are described: X or $\gamma$ ray absorption, electromagnetic flowmeter, current-meter (winch), pressure lowering devices (venturis, diaphragms), hot wire anemometry, resistive probes, phase indicating microthermocouples and optical probes. (FR)

**11920** EXPANSION LYRE-SHAPED TUBE. Andro, J. (to Societe Stein Industrie). French Patent 2,218,528/A/. 19 Feb 1973. 5p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to expansion lyre-shaped tube portions formed in tubular bundles between two bottom plates. An expansion lyre comprises at least two sets of tubes of unequal lengths coplanar and symmetrical with respect to the main tube axis, with connecting portions between the tubes forming said sets. The invention applies to apparatus such as heat exchangers, heaters, superheaters, or breeders. (FR)

**11921** CONDENSATION OF SINGLE VAPOR ON A VERTICAL SURFACE. Hayakawa, T.; Kawasaki, J.; Muraki, M. (Tokyo Inst. of Tech.). Heat Transfer-Jpn. Res.; 4: No. 2, 55-62(1975).

Experimental work was carried out on the condensation of a single vapor on a vertical surface. The condensation of water, ethanol or trichloroethylene from pure vapor of each in the presence of noncondensable gas (air) was investigated. The axial distribution of the condensing wall temperature was measured. The local heat transfer coefficients of the condensate layer were obtained from the condensation of pure vapor and shown to be in good agreement with Nusselt's theoretical equation. The local mass transfer coefficients of the gas phase were obtained from the condensation in the presence of air and were correlated by an empirical equation for a wide range of vapor concentration. (auth)

**11922** TWO-PHASE FLOW BEHAVIOR IN MANIFOLDS AND NETWORKS. Fouda, A. E. Waterloo, Ont.; Univ. of Waterloo (1975). vp. Available at Univ. of Waterloo, Ont. Library.

Thesis (Ph. D.).

The purpose of this research project was to investigate experimentally the bahavior of gas-liquid flow in manifolds and networks. The following sequence of experimentation and analysis was undertaken. Two-phase annular flow in a horizontal tee with a vertical branch was studied. The effects of baffles and homogenizers on downstream qualities were measured. Longitudinal and horizontal pressure changes were measured and interpreted in the light of separated and homogeneous two-phase flow models. Suggestions are made for reducing the phase separation effect of the single tee. The single phase network analysis theory has been reviewed. The hydrodynamic behavior of single phase flow in manifolds and devices which form nodal points in pipeline networks is compared with the corresponding two-phase flow situation. The construction and use of the experimental equipment is

described. Experiments were done in the closed network and the developed venturi correlations were successfully tested to calculate the unknown variables of the flow rates and the qualities in the branches. Excellent agreement has been obtained between the experimental and calculated input variables (such as air and water flow rates, and qualities). The visual observation results (that have been obtained to study the physical behavior of the two-phase flow in the closed network experiments) indicated the existence of either unstable or multisteady-state regions of manifolding behavior. Suggestions are given for more comprehensive future investigations into the instability mechanisms in adiabatic two-phase flow networks. The main contributions of this work are the collection of new accurate data on the behavior of two-phase flow in a network; the investigation and the successful use of the venturi as a two-phase flow metering device; the development of constitutive relations for network components which may form the basis of successful network analysis and design in the future; and the observation and classification of flow patterns, instability and multi-steady state phenomena. (Diss. Abstr. Int., B)

**11923** APPLICABILITY OF THE HOMOGENEOUS FLOW MODEL TO TWO-PHASE FLOW. Husain, A. Cincinnati; Univ. of Cincinnati (1975). 225p. University Microfilms Order No. 75-28,927.

Thesis (Ph. D.).

An improved criterion for the onset of the homogeneous flow pattern in co-current vapor-liquid flow was developed. This criterion was based on the visual flow observations obtained during this study and those available in the literature and is consistent with a general approach to the suspension of small bubbles and particles. One-dimensional momentum theory was used for the prediction of abrupt area change pressure losses in two-phase flow. Pressure change across expansions were well predicted if slip was assumed to occur at all the locations. Pressure drop across contractions were well correlated by assuming slip to occur at all locations except at the vena-contracta where the mixing action was postulated to cause a flow homogenizing effect. Pressure drop across expansion-contraction combinations was also in line with the separate contraction and expansion pressure changes. Two-phase frictional pressure drop in straight pipes and pressure changes across abrupt expansions and contractions are also found to be in accord with the criterion of the onset of the homogeneous flow pattern. (Diss Abstr. In., B)

**11924** DRYOUT AND REWETTING OF A HEATED SURFACE DURING FLOW TRANSIENTS. Sheron, B. W. Washington, DC; Catholic Univ. of America (1975). 210p. University Microfilms Order No. 75-21,539.

Thesis (Ph. D.).

An investigation was performed to determine the dryout and rewetting characteristics of a heated wall in flow boiling during flow transients in which both dryout and rewetting would be predicted to occur. The experimental portion of the investigation utilized Freon-12 as the working fluid at 125°F and 169 psig. Mass flow rates were varied between approximately $0.2 \times 10^6$ and $1.0 \times 10^6$ lbm/hr-ft$^2$ with heat fluxes up to approximately 35,000 Btu/hr ft$^2$. The test section was instrumented to record transient flow rate, coolant inlet temperature, and test section transient wall temperatures at five locations over a five inch region at the downstream end. For transient dryout, the results show that use of steady state dryout correlations in transient analyses will predict dryout to occur in advance of its actual occurrence. For rewetting, analyses were performed using both a constant and temperature-dependent heat transfer coefficient in the wetted wall region with heat transfer to the vapor in the dry wall region. These results indicate that the use of either the constant or temperature-dependent heat transfer coefficients in the wetted wall region will quantitatively describe the observed results. These results show, however, that the value of the wet side heat transfer coefficients required to maintain the interface temperature at the assumed maximum liquid temperature are above those normally expected for nucleate boiling heat transfer. Additionally, these results predicted heat fluxes immediately upstream of the interface in excess of dryout heat fluxes. (Diss. Abstr. Int. B.)

**11925** ANNUAL REVIEW OF FLUID MECHANICS. Volume 8. Van Dyke, M.; Vincenti, W. G.; Wehausen, J. V. (eds.). Palo Alto, CA; Annual Reviews Inc. (1976). 418p.

The following topics on hydraulics or aerodynamics are discussed: hydraulics' latent golden age; useful non-Newtonian models; optical effects in flow; the stability of time-periodic flows; aerodynamics of buildings; mixing and dispersion in estuaries; homogeneous turbulent mixing with chemical reaction; instability in non-Newtonian flow; computation of turbulent flows; hot-wire anemometry; multiphase fluid flow through porous media; currents in submarine canyons: an air-sea-land interaction; boundary-layer stability and transition; turbulent flows involving chemical reactions; and a blunt body in a supersonic stream. (LCL)

## Materials Testing

*Refer also to abstract 12609.*

**11926** DEVICE FOR DISPLAYING DEFECTS IN CONCRETE. Zouboff, V.; Darnault, C.; Leloup, J. C. (to Laboratoire Central des Ponts et Chaussees). French Patent 2,227,791/D/. 26 Apr 1973. 8p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

The device comprises a common gamma source, located on one side of the concrete block to be examined on the opposite side, a detecting unit comprising a collimator and a photo-multiplier detector connected to a display unit and moving along rails parallel to the concrete block face. The device is used for displaying concrete defects in particular injection deficiencies in the prestress sheaths of concrete used for the building of bridges or tunnels. (FR)

**11927** A FOCUSSED ULTRASONIC TRANSDUCER. Roule, M.; Saglio, R. (to CEA). French Patent 2,224,044/D/. 2 Apr 1973. 11p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

This transducer is characterized in that the active surface thereof is a portion of the equiphase surface having a focus, the point of a member where a control is to be carried out; either the pellet or the focussing lens covering the pellet is given such a shape. This can be applied to the control of nuclear fuel element weldings. (FR)

**11928** PROTON RADIOGRAPHIC DETECTION OF MICROPOROSITY IN AERO-ENGINE TURBINE CASTINGS. Stafford, P. (Rolls-Royce Ltd., Bristol, Eng.); Sherwood, A. C.; West, D. Nondestr. Test. (Guildford, Engl.); 8: No. 5, 235-240(Oct 1975).

The clear nondestructive visualization of microporosity in aeroengine turbine blade castings has been demonstrated for the first time using marginal-range proton radiography. The technique is described. This method has now been in use in a practical industrial situation for over a year, during which time more than one thousand turbine blades have been proton-radiographed. Improved casting techniques and changes in the established inspection and control sectioning procedures have resulted from this program. (UK)

**11929** DETERMINATION OF DIFFUSION PROFILES BY AUTORADIOGRAPHY AND THEIR QUANTITATIVE INTERPRETATION. Walis, L.; Bielski, W.; Kaczor, J.; Chajecki, T. (Inst. of Nuclear Research, Warsaw). Nukleonika; 20: No. 6, 573-580 (1975).

In some cases the diffusion profiles obtained by the autoradiographic method differ from the real distribution of the migrating elements. A method for correcting diffusion profiles and their quantitative interpretation was developed. The method permits the migration of elements in thermochemical treatment of metals to be followed and the element content in any area of the diffusion layer to be quantitatively determined. The total error does not exceed 20%. (auth)

## Nuclear Explosions

*Refer also to abstracts 11946 and 12171.*

**11930** (CEL-TR-820) NUCLEAR SHOCK WAVE PROPAGATION THROUGH AIR ENTRAINMENT SYSTEMS OF HARDENED FACILITIES. Fashbaugh, R. H.; Widawsky, A.; Pal, D. Apr 1975. vp.

An analytical study was undertaken to develop the capability of predicting nuclear shock wave propagation through air entrainment systems of hardened facilities. All solutions presented in this report are one-dimensional. Two finite-difference schemes for approximating the hyperbolic partial differential equations of fluid dynamics are used, i.e., the pseudoviscosity scheme in a variable area Lagrange formulation, and the Lax-Wendroff two-step scheme in an Eulerian formulation. Shock wave attenuation due to viscous losses at ducting walls is included. A comparison of the results of the analysis with shock tube experimental data shows both formulations to be adequate. The Eulerian formulation is appropriate for constant area ducts only and is limited to air temperatures below 1000°K. The Lagrange formulation is appropriate for constant or limited variable area ducts or a complete air entrainment system configuration. The Lagrange formulation has the capability of a simple exponential decay shock wave input to temperatures of

1000°K or a 1-MT nuclear shock wave input to temperatures of 24000°K.

**11931** (LA-6097-MS) DETONATION OF HIGH EXPLOSIVES IN LAGRANGIAN HYDRODYNAMIC CODES USING THE PROGRAMMED BURN TECHNIQUE. Berger, M. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1975. Contract W-7405-ENG-36. 9p. Dep. NTIS $4.50.

Two initiation methods were developed for improving the programmed burn technique for detonation of high explosives in smeared-shock Lagrangian hydrodynamic codes. The methods are verified by comparing the improved programmed burn with existing solutions in one-dimensional plane, converging, and diverging geometries. Deficiencies in the standard programmed burn are described. One of the initiation methods has been determined to be better for inclusion in production hydrodynamic codes. (auth)

**11932** (LA-6154-MS) THEORETICAL SIMULATIONS OF THE GAS EXPLOSIVE SIMULATION TECHNIQUES (GEST) EXPERIMENTS. Ruppel, H. M.; Norton, J. L. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1975. Contract W-7405-ENG-36. 7p. Dep. NTIS $4.50.

To calibrate the ability to predict the dynamic behavior of nuclear fireballs the balloon detonations conducted under DNA sponsorship in November of 1973 have been simulated. These well-instrumented shots provide excellent data to test the reliability of hydrodynamic models for the rise and expansion of very low yield explosions. The results of calculations and conclusions drawn concerning the applicability of such techniques to nuclear fireball simulations are presented. (auth)

**11933** (NVO-1163-77) PROJECT LONGSHOT, FINAL REPORT. Analysis of Ground Motion and Containment, Safety Program. (Beers (Roland F.), Inc., Alexandria, Va. (USA)). 6 May 1966. Contract AT(29-2)-1163. 35p. Dep. NTIS $4.00.

Predictions of ground motions and containment were made for the Longshot event. Limits on the areas expected to be within the radius of potential damage (acceleration 0.1 g) and perceptible motion (acceleration 0.001 g) were given. Also, prediction graphs were presented for obtaining peak particle acceleration, displacement and velocity for points of interest on hardrock and unconsolidated material. A preliminary feasibility study was performed to determine the acceptability of the proposed Longshot site from the standpoint of containment and seismic safety. The results of the investigation showed the proposed Longshot event could be successfully executed at the selected location. Subsequently, an exploratory drilling program was performed and a stemming plan was developed. Based upon the findings of the exploratory program and the evaluation of the stemming plan, Beers, Inc. concluded that the event would be contained at the proposed location. Upon detonation, containment was achieved as predicted. No reports of damage or ill-effects due to excessive motions were made. A limited comparison with published ground motion data indicates satisfactory predictions. (auth)

**11934** (PNE-MHF-3) RIO BLANCO MASSIVE HYDRAULIC FRACTURE WELL RB-MHF-3 AS-BUILT REPORT. (CER Geonuclear Corp., Las Vegas, Nev. (USA)). Aug 1975. 138p. Dep. NTIS $10.00.

The complete drilling operation for well RB-MHF-3, including the surface equipment and services, downhole equipment and services, and cementing, are reported. Appendices give the daily drilling reports, casing records, drilling bit summary, mud properties, core analysis data, drill stem test data, and gas and water analyses. (JSR)

**11935** (PNE-RB-73) PROJECT RIO BLANCO FORMATION EVALUATION WELL (RB-U-4): DRILLING, COMPLETION, AND INITIAL TESTING REPORT. (Energy Research and Development Administration, Las Vegas, Nev. (USA). Nevada Operations Office). Dec 1975. 60p. (NVO-168). Dep. NTIS $4.50.

Rio Blanco Well RB-U-4 is a gas reservoir evaluation well drilled to a depth of 7,000 feet in the Piceance Basin of northwestern Colorado. This well is a part of Project Rio Blanco whose goal is to demonstrate the potential for commercial development of low-permeability gas reservoirs by nuclear explosive stimulation. Well RB-U-4 was drilled approximately 624 feet from the surface location of the nuclear emplacement well and outside the fractured zone produced by the explosives to obtain information on the undisturbed gas reservoir. The drilling, completion, and initial testing of Rb-U-4 including drilling reports, drill bit records, logging records, hole deviation data, casing and cementing descriptions, hydraulic fracturing procedures, flow testing information, and current surface and downhole equipment configuration are described. (auth)

**11936** (UCID-16969) FRICTIONAL EFFECTS BETWEEN OVERTON SAND AND A SIMULATED CASING FOR A BORE HOLE. Dong, R. G. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 6 Oct 1975. Contract W-7405-Eng-48. 28p. Dep. NTIS $5.00.

A series of tests were run to simulate the frictional effects between Overton sand and the casing for a bore hole for an underground nuclear test. The objective was to find a description for this frictional interaction which can be applied to an analysis of stemming materials under field conditions. (TFD)

**11937** (UCRL-51919) EFFECT OF STRESS ON THE MICROSTRUCTURE OF A GRAYWACKE SANDSTONE FROM THE SITE OF THE RIO BLANCO GAS-STIMULATION EXPERIMENT. Dengler, L. A. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 30 Sep 1975. Contract W-7405-Eng-48. 34p. Dep. NTIS $4.00.

Project Rio Blanco was designed to increase rock permeability in an existing gas reservoir by fracturing the rock with a vertical array of three simultaneous nuclear explosions. The project site was CER Geonuclear hole RB-E-01, Section 14, T35, R98W, Rio Blanco County, in the Piceance Creek Basin of northwest Colorado. The most essential part of this project was to produce fracturing in, and thereby to increase the permeability of, the reservoir rock. This report contains the results of optical and scanning electron microscope (SEM) studies done on unstressed and laboratory-stressed samples of graywacke sandstone from the 6458-ft level of the emplacement hole. Laboratory-stressed samples were from uniaxial-stress and uniaxial-strain tests made as part of equation-of-state measurements used to provide input parameters for preshot code calculations. (auth)

**11938** SOME ASPECTS OF PEACEFUL USES OF ATOMIC ENERGY. Ramanna, R. (Bhabha Atomic Research Centre, Bombay (India)). Phys. News; 5: No. 3, 104-109(Sep 1974).

A talk delivered at the Saha Institute of Nuclear Physics, Calcutta, on 7 June 1974.

Developments in the field of atomic energy in India over the last two decades are outlined. The planning of the atomic energy program in accordance with the needs of the country and the available resources is explained. The factors leading to the transition from thermal reactors to fast reactors are discussed. The first peaceful explosion experiment carried out in India is dealt with in detail. The crater and chimney type of explosions are discussed. The applications of these explosions in oil exploration and other geological investigations are mentioned. The importance of mustering indigenous expertise and resources in achieving progress in the nuclear field is discussed. (INIS)

**11939** NEW PROPOSALS TO DEVELOP THE QATTARA DEPRESSION. Bassler, F. (Univ., Darmstadt, Ger.). Int. Water Power Dam Constr.; 27: No. 8, 291-297(Aug 1975).

Generating hydropower economically by connecting the Qattara depression to the Mediterranean might be feasible using nuclear explosions to blast the linking canal. Possibly greater benefit could be obtained by incorporating a pumped-storage scheme. (auth)

**11940** ADVISORS: OPPENHEIMER, TELLER, AND THE SUPERBOMB. York, H. F. San Francisco; W. H. Freeman and Company (1976). 175p. $6.95.

The technical, strategic, and human aspects of the great debate begun in late 1969 which led to the decision to build the first hydrogen bomb are reviewed. Chapters are included on the atomic bomb programs in the US and USSR to 1949; discussions which led to President Truman's approval of the superbomb project; the H-bomb programs; a review of the advice of the General Advisory Committee of the USAEC and of its chairman J. Robert Oppenheimer; and the major consequences of the decision to develop the superbomb. (LCL)

## Protective Structures and Equipment

*Refer also to abstract 11519.*

**11941** FLUID CONTROL PUMP. (to British Nuclear Fuels Ltd.). French Patent 2,217,572/A/. 31 Oct 1973. Priority Date 1 Nov 1972, United Kingdom of Great Britain and Northern Ireland (UK). 9p. (In French).

Available from Institut National de la Prioriete Industrielle, Paris (France).

The pump is characterized in that it has a device to subject the fluid to be pumped to repeated pulsations when the fluid is enclosed in a chamber having input and output fittings. In each fitting a fluid valve is mounted in such a way that the pulsations facilitate the penetration of the fluid into the chamber through the fluid valve of the input fitting and also facilitate the output of this fluid from the chamber through the output valve. Since the fluid output from the chamber by the fluid valve of the input fitting is reduced, the

device has an aspiration section connecting the chamber to an ejector which has a channel connected to a compressed gas feed. It also has an element on which the pump fluid acts so as to shut this channel intermittently. (tr-FR)

**11942** RETENTION AND PENETRATION CHARACTERISTICS OF A GLASS FIBER FILTER FOR $^{212}Pb$ AGGREGATE RECOIL PARTICLES. Ryan, M. T.; Skrable, K. W.; Chabot, G. (Lowell Technological Inst., MA). Health Phys.; 29: No. 5, 796-798 (Nov 1975).

The results of an investigation of the retention and penetration characteristics of glass fiber filters (Gelman Type A) for $^{212}Pb$ aggregate recoil particles are reported. The aggregate particle generation and test filter system, consisting of a stack of filters in series, are described. The apparent retention of the first filter was found to be much lower than the value expected for the size of aggregate particle under test. The mechanism whereby there is a net transfer of aggregate radioactive material from the first filter, the most probable site of deposition, to downstream filters in the series, which is considered to be a direct result of the aggregate recoil phenomenon, is considered. The results show that the aggregate recoil phenomenon can increase the effective penetration of aggregate recoil particles through glass fiber filters and, therefore, lower the effective retention of the filter. (UK)

# ENVIRONMENTAL AND EARTH SCIENCES

*Refer also to abstract 11778.*

**11943** (BNWL-SA-5347) INVESTIGATION OF REGIONAL FLOW PATTERNS FOR IMPROVING ESTIMATES OF EFFLUENT TRANSPORT AND DIFFUSION. Elliott, D. L.; Sandusky, W. F.; Woodruff, R. K. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1975. Contract E(45-1)-1830. 24p. (CONF-751138-1). Dep. NTIS $4.00.

From annual meeting of Pacific Northwest International Section Air Pollution Control Association; Vancouver, B. C., Canada (19 Nov 1975).

Regional wind flow patterns and transport in the lower planetary boundary layer were examined from a network of 29 wind recording stations over the Mid-Columbia Region of Washington and Oregon. Spatial and temporal variability in the computed wind fields were analyzed from hourly data during November 1974 over a study area of 170 by 190 km. Much of the surface variability in flow appears to be due to topographical effects. From an investigation of the non-frontal situations, there is evidence that regional flow types could be classified, to some extent, by surface pressure patterns. Based on this study, long-term or regional transport based entirely on 850 mb flow could be in serious error. Techniques for improving estimates of regional transport, through the adoption and modification of an existing model and the utilization of regional data are examined. Applications of these techniques to various facets, i.e., environmental impacts from potential industrial and nuclear development, are discussed. (auth)

**11944** (CONF-751066-1) SUSCEPTIBILITY OF THREADFIN SHAD TO IMPINGEMENT. Griffith, J. S.; Tomljanovich, D. A. (Oak Ridge National Lab., Tenn. (USA); Tennessee Valley Authority, Norris (USA)). 1975. 26p. Dep. NTIS $4.50.

From southern division of American Fisheries Society meeting; Norris, Tennessee, USA (12 Oct 1975).

Threadfin shad (Dorosoma petenense) impingement at 13 Tennessee Valley Authority electric generating facilities was monitored from August 1974 through June 1975 to assess possible mortality resulting from low water temperature. Concurrent experiments were conducted to evaluate the ability of cold-stressed threadfin shad to avoid impingement. In the laboratory, temperatures of 12°C stressed threadfin shad and those below 8°C caused high impingement mortality. At 5 of 12 fossil-fuel plants 85 percent or more of the annual impingement occurred when water temperatures were below 10°C. At 4 plants impingement was not related to low temperatures. Impingement at Browns Ferry nuclear plant correlated generally with low water temperatures but individual impingement peaks were not consistently associated with temperature shocks. (auth)

**11945** (KFK-2181) METEOROLOGICAL DATA ACQUISITION SYSTEM. Functional Description and General Characteristics of the Different Components. Bouharrour, S.; Thomas, P. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Jul 1975. 157p. (In German). Dep. NTIS (US Sales Only) $7.75.

The 200 m meterorological tower of the Karlsruhe Nuclear Research Center has been equipped with 45 instruments measuring the meteorological parameters near the ground level. Frequent inquiry of the instruments implies data acquisition with on-line data reduction. This task is fulfilled by some peripheral units controlled by a PDP-8/I. This report presents details of the hardware configuration and a short description of the software configuration of the meteorological data acquisition system. The report also serves as an instruction for maintenance and repair work to be carried out at the system. (auth)

**11946** (SAND-75-5742) MINE-BACK MAPPING OF HYDRAULIC FRACTURES. Tyler, L. D.; Vollendorf, W. C. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 3p. (CONF-751101-25). Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

As part of the overall study of containment for underground nuclear testing, hydraulic fracture experiments were performed in the vicinity of tunnel complex "U12g" which is near the southeast edge of Rainier Mesa, located on the Nevada Test site. The results presented are of two forms: the mapping of the cracks formed during the fracture tests and the in situ stresses data obtained for Rainier Mesa. In horizontal boreholes the fractures appeared to initiate along an elliptical path around the borehole with no direction change of the fracture in the formation. The in situ stresses dominated the fracture behavior at the borehole and in the formation. (JSR)

**11947** (US-IBP-74-3(Vol.4)) ABSTRACTS: US-INTERNATIONAL BIOLOGICAL PROGRAM. Ecosystem Analysis Studies. Kemp, H. T. (ed.). (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 75p. Dep. NTIS $5.50.

Approximately 200 abstracts are presented of studies related to the eastern deciduous forest biome, the grassland biome, and the tundra biome. The following indexes are included: author, keyword, taxonomic name, and subject category. (HLW)

**11948** METHOD OF VALUATION OF WATER FIELD CAPACITY. Dancette, C. (Institut de Recherches Agronomiques Tropicales et des Cultures Vivrieres, Bombay (Senegal)); Maertens, C. (Institut National de Recherches Agronomiques (INRA), 31-Toulouse (France). Station d'Agronomie et d'Oenologie). Sci. Sol.; No. 3, 165-171(1973). (In French).

A method allowing the obtention of an approximation of field capacity, with only the determination of water retention at pF = 3, is described. In alluvial soils, the accuracy of this method appears sufficient to satisfy the current needs in agriculture problems. (FR)

**11949** RADIOACTIVE DIFFUSION FROM A NUCLEAR POWER STATION. Haekkinen, H. H. Sahko; 48: No. 3, 131-137(Mar 1975).

According to the calculation methods presented a 3,000 MW(th) example nuclear power station in normal operation causes an integrated concentration of $3 \times 10^{-8}$ Ci × s/m$^3$ and a fallout of $8 \times 10^{-10}$ Ci/m$^2$ at a distance of 1 km in the worst direction, the release being 0.5 Ci-I-131. The ratio of these concentration and fallout values and the effects of a 3, 2 and 1-shell containment in conjunction with a design basis accident is $1 : 6 \times 10^4 : 10^6 : 2 \times 10^7$. The calculation methods allow for, e.g., various temperature inversions with discontinuity surfaces. They can be used to estimate e.g. concentrations close to the containment and the effects of downwash caused by the chimney. (auth)

## Minerals and Ores

*Refer also to abstracts 11430, 11431, 11434–11436, 11461–11463, 11545, 12187, 14221, and 14222.*

**11950** (KURRI-TR-122, pp 25-28) DISTRIBUTION OF HEAVY ELEMENTS IN ROCKS AND MINERALS. Nishimura, S. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

The author presents firstly some theoretical formulae for the concentration of rare elements in the course of the solidification of magma, using the distribution coefficient in liquid phase and solid phase $K_l$ and $K_s$, for both cases involving and not involving crystal fractionation. $K_l$ is also a function of the difference of ionic radius $\Delta R$, for a given amount of crystals crystallizing from magma. These relations lead to the recognition of the general tendency of rare heavy elements to concentrate in residual liquid, from which rare elements with enriched U and Th crystallize out. On this basis, the author made some prospect for various possible places where the concentration of other heavy elements, such as $^{244}$Pu, No. 110 and No. 114, will be found with consideration of their ionic radii and ionic charge.

**11951** (NP-20730) INTERNATIONALIZATION IN THE SECTOR OF CONSTRUCTION OF ELECTRICAL AND PARTICULARLY NUCLEAR POWER PLANTS. Erdemli, H.; Real, B. (Grenoble-1 Univ., 38 (France)). Oct 1974. 237p. (In French). Dep. NTIS (US Sales Only) $9.00.

The impact of the 1973 to 1974 oil crisis on the nuclear power policies of the industrialized nations is reviewed. The construction of nuclear power plants in these countries, including current projects, is examined in some detail. Some trends concerning the domination of the nuclear and electrical power plant industry by U.S.-based corporations are discussed. (JWR)

**11952** OKLO: SOME FOSSIL REACTORS. Naudet, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Div. d'Etude et de Developpement des Reacteurs). Recherche (Paris); 6: No. 57, 508-518(Jun 1975). (In French)

During the summer of 1972 it was discovered that fission chain reactions had arisen spontaneously in the very distant past inside a Gabon uranium deposit where certain zones functioned as nuclear reactors for hundreds of thousands of years. Subsequent research showed these reaction centres to be still in a remarkable state of preservation, thus allowing this amazing geological phenomenon to be studied in detail. (FR)

**11953** URANIUM AND THORIUM ENRICHED PROVINCE OF THE FENNOSCANDIAN SHIELD IN SOUTHERN NORWAY. Kileen, P. G.; Heier, K. S. (Oslo Univ.). Geochim. Cosmochim. Acta; 39: No. 11, 1515-1524(Nov 1975).

The precambrian Fla, Iddefjord, and Bohus granites lie along a line striking roughly northwest which crosses the Permian Oslo Province to the southwest of Oslo. Radioelement investigations in the three bodies show that they all contain abnormally high thorium and uranium concentrations relative to the published literature on average radioelement contents of granitic rocks. Trend surface analysis of the radioelement distribution in the Iddefjord granite suggests there was relative movement of uranium to the east with respect to thorium, possibly as the result of Permian activity in the adjacent rocks. Geological considerations, radiometric evidence and published gravimetric data suggest that the 3 granites represent a continuous belt enriched in thorium and uranium during the Sveconorwegian orogeny. A portion of the belt was later involved in the Permian igneous activity which produced the igneous Oslo Province. There is some evidence that the Permian Drammen and Finnemarka granites represent that part of the belt which was modified in Permian time. (auth)

**11954** RADIOAKTIVNYE ELEMENTY V GORNYKH PORODAKH. (Radioactive Elements in Rocks. Reports of the First Radiogeochemical Congress Held 15–19 May 1972 at Novosibirsk, USSR). Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). 296p. (CONF-7205116-).

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972).

The principal problems of the geochemistry of radioactive elements are examined in this collection of 51 papers. New information is presented on the distribution and behavior of radioactive elements in the processes of formation of magmatic and metamorphic rocks, sedimentary deposits, and weathering crusts. Data on U and Th in hydrothermal processes and in the oceans, seas, and underground waters are presented. Methods for the determination of U and Th, their regional distribution, and forms of occurrences in different geological objects are described. Some questions of radiogeology (geothermics, nuclear effects, and isotopes) are considered. Individual abstracts were prepared for each paper. An extensive bibliography is appended. (tr-auth)

*For abstracts of individual papers see: 11434–11436, 11461–11463, 11545, and 11955–11998.*

**11955** PRINCIPAL STAGES IN THE DEVELOPMENT OF THE GEOCHEMISTRY OF RADIOACTIVE ELEMENTS. Komlev, L. V. pp 6-10 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Historical data on the development of radiogeochemical investigations throughout the world are presented. Three of the stages are identified and characterized. On the basis of the achievements of the present stage the value of radiogeochemistry for contemporary science is shown for the areas of petrology, metallogenesis, absolute geochronology, and geoenergetics. The possibility of constructing radiogeochemical charts of all the territory of the USSR is discussed. (tr-auth)

**11956** URANIUM AND THORIUM IN MINERAL SUBSTANCES OF THE EARTH'S CRUST. Smyslov, A. A. pp 10-18 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

A comparative analysis is given of the singularities of the distribution and form of occurrence of radioactive elements in minerals of the earth's crust. Different "levels of organization" of the materials are used: minerals, rocks, geological formations, structural-facies complexes, and individual strata of the crust. (tr-auth)

**11957** URANIUM IN SEDIMENTARY ROCKS. Al'tgauzen, M. N. pp 19-30 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Present concepts on the distribution of U in ordinary rocks, coals, peats, and phosphate and bauxite rocks are analyzed in detail on the basis of a review of the studies of others. The migration process, form of occurrence of U in sediments, role of liquids, and the theory of the exogenic ore formation are considered. (tr-auth)

**11958** SOME SINGULARITIES OF THE GEOCHEMISTRY OF URANIUM IN CARBONIFEROUS DEPOSITS. Danchev, V. I.; Vinokurov, S. F.; Neimyshev, M. V.; Ol'kha, V. V.; Ostrovskaya, G. Ya.; Rasulova, S. D.; Strelyanov, N. P. pp 31-38 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

On the basis of the formation of increased concentration of U in peat moss, lignite, brown coal, bituminous coal, and secondary bitumens possible forms of its concentration were examined. These included sorption, ion exchange, uranium-organic complexes, and natural minerals. Grounds were given for the conclusion that in such a sequence occurs the evolution of the bonding of U with the organic material of sedimentary rocks at different stages of lithogenesis. (tr-auth)

**11959** RADIOGEOCHEMICAL SINGULARITIES OF GEOSYNCLINAL DEPOSITS OF GORNO-ALTAI AND WESTERN SAYAN. Mitropol'skii, A. S.; Mel'gunov, S. V.; Nosova, T. G.; Raevskii, V. P. pp 38-45 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The behavior of U and Th in the process of evolution of stratified deposits of folded structures of Gorno-Altai and western Sayan was examined in the interval from late reef primary geosynclines up to the consolidation of a migratory zone in the middle paleozoic. It was established that almost all the U and Th in the terrigenic rocks occur in chlorites, sericites, and epidotes, appearing during the recrystallization of the primary lithographic material during diagenesis and metamorphism of the facies of green schist. (tr-auth)

**11960** RADIOACTIVE ELEMENTS IN SEDIMENTARY ROCKS OF SCYTHIAN-TURANIAN PLATFORM AND ITS MOBILE PARTS. Shor, G. M.; Vorob'ev, V. P.; Girin, Yu. P. pp 45-52 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The radiogeochemical singularities of the platform and orogenic series of formations are examined. Three age epochs of syngenetic accumulation of U in the sediments are shown. Questions of the migration and precipitation of U are discussed for different climatic zones. The possibility of using the Th/U ratio for separation of the arid and humid formation of the continents is considered. It is also considered for the division of orogenic, suborogenic, and platform regions. (tr-auth)

**11961** RADIOACTIVE ELEMENTS IN WEATHERING RESIDUES. Krendelev, F. P. pp 52-57 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Ancient and contemporary weathering residues of humid regions on the Yenisei crest, in the Western Siberian lowlands, in the northern and southern Urals, and in Zaangar and Sayan were studied. The regularities in the distribution of radioactive elements in weathering residues were reported. It was concluded on the basis of these regularities that radiochemical criteria can be an indicator of the degree of weathering of rocks and a correlator for the separation of weathering profiles into zones. (tr-auth)

**11962** URANIUM SORBENTS IN SEDIMENTARY ROCKS AND PROBLEMS OF ORIGIN OF ORE-FORMING SOLUTIONS. Gavshin, V. M.; Bobrov, V. A.; Pyalling, A. O.; Lavrent'ev, Yu. G. pp 57-63 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The phenomena of sorption concentrations of U in natural stratified aluminosilicates, Ca phosphates, and Ti hydroxides were examined. Geological materials and experimental models led to conclusions on the chemosorption process of the accumulation of U in natural sorbents. In a series of cases U was easily desorbed by carbonate solutions which indicates the two-stage process with the original solutions of U in sorbents and subsequent appearance of uranium materials. (tr-auth)

**11963** BASIC TYPES OF URANIUM-CONTAINING MATERIALS IN ROCKS. Uspenskii, V. A.; Pen'kov, V. F. pp 63-67 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The regularities of uranium-containing bitumens are described. The types of urano-bitumen association are indicated. Some forms of the U presence in bitumen material of sedimentary, metamorphic, and volcanic rocks are characterized. (tr-auth)

**11964** REGULARITIES OF THE DISTRIBUTION OF RADIOACTIVE ELEMENTS IN PHOSPHORITES AND THEIR USE IN PROSPECTING FOR PHOSPHATE RAW MATERIALS IN SIBERIA. Laubenbakh, A. I.; Levina, S. D.; Skosyreva, L. N.; Slavyagina, I. I.; Stepanova, E. P.; Tsytovich, B. L. pp 68-72 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The results of the investigation of the distribution of the natural $\gamma$ field of the earth's surface in phosphorite ore deposits were reported. An analysis of the concentration of the radioactive elements showed that for phosphorites an increased concentration of U (Ra) and a decreased Th concentration and therefore abnormal values of the U/Th ratio are characteristic. This can be used as an evaluation criterion during prospecting for phosphorite ore deposits. (tr-auth)

**11965** URANIUM AND THORIUM IN SEDIMENTARY ROCKS OF A GEOSYNCLINE-FOLDED SYSTEM IN EASTERN KAZAKHSTAN. Grigor'ev, K. A.; Alekseenko, V. D.; Baranov, G. M.; Gortsevskii, A. A.; Smirnova, A. D. pp 72-76 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The regularities of the primary distribution of radioactive elements of different lithological-facial zones are reported. The reasons for the variability of their concentration are discussed in connection with the geological history of the region. (tr-auth)

**11966** RADIOACTIVITY AND ABSOLUTE AGE OF OCEAN SEDIMENTS. Kuznetsov, Yu. V.; Legin, V. K.; Elizarova, A. N.; Simonyak, Z. N. pp 76-81 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The distribution of Th, I, U, Ra, and Pa in suspensions and sediments of the seas and oceans was reported. The means of their accumulation in the ocean sediments and the methods of determining the rate of sedimentation were discussed. (tr-auth)

**11967** URANIUM IN MAGMATIC PROCESSES. Tugarinov, A. I. pp 82-86 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The basic theses of magmatism and ore formation are discussed. The constant value of the Th/U ratio in different phases of intrusion indicated the stable bond of U and Th with the melt. The migration activity of the radioactive elements in magmatic processes in the course of geological time increases which agrees with the data of Pb-U-Th isotopes. The process of differentiation of the earth's crust began in the early Proterozoic, but granites, incipient even in the differentiating strata, inherits the composition of the latter. (tr-auth)

**11968** RADIOGEOCHEMICAL SINGULARITIES AND SOME QUESTIONS OF THE EVOLUTION OF INTRUSIVE MAGMATISM OF FOLDED REGION OF WESTERN SIBERIA. Zhuravlev, R. S.; Osipov, D. K.; Il'inskii, Yu. V.; Shaposhnikov, G. N. pp 86-90 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The exhibition of granitoid magmatism in activation zones of Altai-Sayan folded region and its radiogeochemical singularities are examined. A systematic study of the granitoid formations of this region using radiogeochemical methods made it possible to establish not only the regularities in the distribution and behavior of radioactive elements in the post-magmatic processes but showed a new area of the exhibition of young magmatism of the activation zone. (tr-auth)

**11969** GEOCHEMISTRY OF THORIUM AND URANIUM IN ALKALI ROCKS. Gerasimovskii, V. I. pp 90-94 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The distribution of U and Th in alkali rocks was characterized. The increase of their concentration is a function of the stage of magmatic differentiation in the debatable relation of these elements with the acid-alkali characteristics of the rocks. The probable sources of U in the ore process were indicated. (tr-auth)

**11970** COMPARATIVE CHARACTERISTICS OF THE BEHAVIOR OF URANIUM AND THORIUM IN PROCESSES OF VOLCANIC AND PLUTONIC MAGMATISM. Kovalev, V. P. pp 95-101 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Information was reported on the use of data on the distribution of U and Th during the formation analysis of magmatism products and in petrological structures. The possibility of establishing the actual nature of the magma by supplementing the petrological characteristics of rocks with radiogeochemical data was indicated. A method was proposed which gives a qualitative and quantitative illustration of the loss of U by intrusive chambers. The conditions favoring this were determined. The most probable mechanisms for the movement of radioactive elements in natural melts were examined. (tr-auth)

**11971** RADIOACTIVE ELEMENTS IN THE VOLCANIC ROCKS OF KAMCHATKA. Leonova, L. L.; Puzankov, Yu. M.; Kirsanov, I. T.; Ydal'tsova, N. I. pp 101-106 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

In modern, Quaternary, and Neogenic rocks of Kamchatka, the increase of the U and Th content from the basic to the acid varieties during their comparatively low concentration in volcanic Neogenic complexes was characteristic. The magmatic rocks are products of fusion of the crust material and radiochemically comparable with deep metamorphic rocks. (tr-auth)

**11972** SINGULARITIES OF THE DISTRIBUTION OF URANIUM AND THORIUM IN VOLCANIC ROCKS. Shatkov, G. A.; Shatkova, L. N. pp 106-112 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The behavior of the radioactive elements in effusive rocks of different basicity-liparites, andesites, and andesite-basalts-was compared. These rocks were also compared with granites. (tr-auth)

**11973** GEOCHEMISTRY OF URANIUM AND THORIUM IN GRANITOID INTRUSIVES OF WESTERN UZBEKISTAN. Khamrabaev, I. Kh.; Magdiev, R. A. pp 112-114 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

According to radiogeochemical indications in granitoids of western Uzbekistan, three subzones were established in one metallogenic zone. From north to south in the zone the mean U and Th concentration alternates from low-clarke to superclarke. Post-magnetic changes led to the relative increase of the quantity of super-clarke U. Albitization led to enrichment but muscovitization and tourmalinization led to a decrease of the absolute U concentration. (tr-auth)

**11974** URANIUM AND THORIUM IN DIFFERENTIATED BASALT SERIES OF THE FAR EAST, SIBERIA, URALS, AND CAUCASIANS. Kravchenko, S. M.; Zaitsev, E. I.; Zolotarev,

B. P.; Ifantopulo, T. N.; Sobolev, S. V.; Shatagina, E. V. pp 115-120 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The concentrations of U, Th, and K in the basalt complexes of the southern Urals, traprocks of Siberia, comagmatic series of Cenozoic volcanoes of the Kuril Islands, Caucasians, and the upper southern volcanoes of central Aldan were compared. The distribution of U and Th can be explained on the basis of concepts on the equilibrium ratio of the melts with the crystals and gravitational jigging of the latter. (tr-auth)

**11975** COMPARATIVE ANALYSIS OF THE BEHAVIOR OF RADIOACTIVE ELEMENTS IN MAGMATIC FORMATIONS OF THE SOUTHERN URALS. Saltykov, V. F.; Rikhter, Ya. A. pp 121-125 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The distribution of U and Th in effusive and intrusive formations of pre-orogenic and orogenic stages of the eastern slopes of the southern Urals was described. An increase in the concentration of these elements toward the concluding stages of magmatism was established. A comparison was made of the radiogeochemical characteristics of the effusive and intrusive formations and of the granitoid series of volcanic and plutonic association. The possibility of using the radiogeochemical data for the formation analysis of magmatic rocks was shown. (tr-auth)

**11976** BEHAVIOR OF URANIUM AND THORIUM IN THE FORMATION AND TRANSFORMATION OF LATE PALEOZOIC GRANITOIDS OF THE URALS. L'vov, B. K.; Petrova, N. I. pp 125-129 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The regularities in the behavior of U and Th in connection with the evolution of late Paleozoic granitoid magmatism were examined. The behavior of the radioactive elements was characterized in different stages of ultrametamorphism and in post-magmatic processes. (tr-auth)

**11977** SOME REGULARITIES IN THE DISTRIBUTION OF URANIUM AND THORIUM IN INTRUSIVE ROCKS OF THE PAMIRS. Aver'yanov, G. S.; Mogarovskii, V. V.; Kozyrev, V. I.; Lutkov, V. S.; Akramov, M. B.; Belyaeva, R. T.; Dmitriev, E. A.; Idrisova, L. V.; Meskhi, A. M.; Peikre, Yu. B. pp 129-132 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The behavior of U and Th in the process of differentiation of granite magma of intrusive complexes of the northern and southern Pamirs was characterized. (tr-auth)

**11978** URANIUM IN METAMORPHIC ROCKS AND PROCESSES. Belevtsev, Ya. N.; Komarov, A. N. pp 133-140 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The general regularities in the distribution of U in metamorphic and ultrametamorphic rocks of shields and massives of pre-Cambrian age were characterized. The basic tendencies of the mobility of U in rocks during progressive metamorphism, ultrametamorphism, diaphthoresis, and some hydrothermal processes were discussed. (tr-auth)

**11979** PHYSICAL-CHEMICAL REGULARITIES OF THE REDISTRIBUTION OF RADIOACTIVE ELEMENTS DURING PROGRESSIVE METAMORPHISM OF ROCKS. Ermolaev, N. P. pp 140-146 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

On the basis of the statement of a theory of chemical precipitation and recrystallization of materials, the mechanism of the redistribution of radioactive elements U and Th during increase of temperature and pressure and the mechanism of their geochemical migration was analyzed. (tr-auth)

**11980** URANIUM AND THORIUM IN THE PROCESS OF FORMATION OF ROCKS OF ZONAL METAMORPHIC COMPLEXES. Mel'gunov, S. V.; Mitropol'skii, A. S.; Kulik, N. A. pp 146-151 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

On the example of zonal complexes of metamorphic rocks in the Altai Mountains the dependence of the behavior of U and Th on the composition of the initial rock, and on the degree and character of the metamorphism in the temperature interval of green schist–ambolite facies was shown. The intense loss of U during metamorphism of the pelite sediment under conditions of transition from green-schist facies to low-temperature stage of epidote–ambolite facies was established. It was also established for rocks of a basic composition during very high-temperature changes. (tr-auth)

**11981** URANIUM AND THORIUM IN PROCESSES OF REGIONAL METAMORPHISM. Titov, V. K.; Bilibina, T. V.; Kochkin, G. B. pp 151-154 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The singularities of the distribution of U and Th in regional metamorphized sedimentary, sedimentary-volcanic, and volcanic rocks were examined. Questions related to the processes of ultrametamorphism and granitization were considered. (tr-auth)

**11982** BEHAVIOR OF RADIOACTIVE ELEMENTS IN HYDROTHERMAL PROCESSES. Naumov, G. B. pp 155-161 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Investigations of the geochemistry of radioactive elements in post-magmatic processes were generalized for regions of increased temperature and pressure. The physical-chemical conditions determining the horizontal and vertical migration of U and Th and their deposition were analyzed. (tr-auth)

**11983** URANIUM AND THORIUM DURING HYDROTHERMAL METAMORPHISM OF ROCKS. Plyushchev, E. V. pp 161-166 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The path of movement of hydrothermal solutions from their origin to the site of their breakdown was described. The basic tendencies of the behavior of U and Th in the evolving solutions (argillization, formation of secondary quartzes, and greisenization) were discussed. (tr-auth)

**11984** GEOCHEMISTRY OF THORIUM IN HYDROTHERMAL PROCESSES. Turovskii, S. D.; Abakirov, Sh. A. pp 166-171 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The most characteristic Th mineral-geochemical associations and the effect of Th accessory minerals on its geochemistry were reported. An analysis was given of the mobile form of Th compounds and its mineral form in hydrothermal associations. The conditions favoring the participation of Th in hydrothermal processes were discussed. (tr-auth)

**11985** RADIOACTIVE ELEMENTS IN GEOLOGICAL FORMATIONS OF THE PALEOZOIC FOLDED STRUCTURES OF THE ALTAI-SAYAN RANGE. Il'inskii, Yu. V.; Zhuravlev, R. S.; Kudryavtsev, V. E.; Osipov, D. K.; Komarnitskii, G. M. pp 178-183 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The radiogeochemical characteristics of complexes of geological formations during subsequent change of the geotectonic regime were reported for Altai-Sayan folded ranges. The general radiogeochemical singularities of the region were given. (tr-auth)

**11986** RADIOACTIVE ELEMENTS IN PRE-CAMBRIAN YENISEI RIDGE. Nozhkin, A. D.; Krendelev, F. P.; Mironov, A. G. pp 183-189 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The pre-Cambrian Yenisei ridge was examined to determine the behavior of radioactive elements in sedimentary and magmatic processes and during progressive and regressive metamorphism. The high degree of inhomogeneity of their distribution and ratio in the region was established. The increased concentration of these elements was characteristic for geochemically much differentiated formations of the east and particularly the central zone of the ridge. (tr-auth)

**11987** RADIOGEOCHEMICAL SINGULARITIES OF GEOLOGICAL FORMATIONS OF THE TRANSBAIKAL REGION. Shuvalov, Yu. M.; Vysokoostrovskaya, E. B.; Shatkov, G. A.; Gushchin, E. N.; Gol'berg, V. L. pp 189-194 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From first radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The regional radiogeochemical zonality of the Transbaikal region, closely connected with its geological structure, was established. The singularities of the distribution of U and Th in rocks of the zone defined were described. (tr-auth)

**11988** RADIOACTIVE ELEMENTS IN METAMORPHIC AND VOLCANIC ROCKS OF THE SOVIET CARPATHIAN MOUNTAINS. Goncharuk, A. F.; Zhukov, F. I.; Koptyukh, Yu. M.; Lesnoi, D. A.; Naumenko, V. V.; Bystrevskaya, S. S.; Mel'nichenko, B. F. pp 194-198 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Data were reported on the U concentration in rocks of the Carpathian folded region and on the U, Th, and K concentrations in volcanically formed Transcarpathian internal downwarp. (tr-auth)

**11989** REGULARITIES OF THE DISTRIBUTION OF RADIOACTIVE ELEMENTS IN THE PRE-CAMBRIAN SEDIMENTS OF TRANS-ANGARA PART OF THE YENISEI RIDGE. Zlobin, V. A.; Kulikov, A. A.; Bobrov, V. A. pp 198-203 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The concentration of U, Th, and K in rocks of the pre-Cambrian part of the Yenesei ridge was determined by $\gamma$ spectrometric methods. Increased concentrations of U were characteristic for the carbonaceous-clay schist lying between the carbonate and clay sediments. Th was concentrated in high-alumina rocks and K in clay deposits from cycles with the highest sedimentation. (tr-auth)

**11990** PRINCIPLES OF RADIOGEOCHEMICAL REGIONALIZATION OF FOLDED AND PLATFORM REGIONS OF THE EARTH'S CRUST. Smyslov, A. A.; Titov, V. K.; Shor, G. M. pp 204-208 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The principles of the construction of radiogeochemical maps on the basis of changes of the primary-constitutional distribution of U and Th were described. On the basis of the geochemical regionalization an attempt was made to analyze the most general regularities of the distribution of the radioactive elements in different types of geological structures and to indicate the primary epochs for the accumulation of metals. (tr-auth)

**11991** RADIOGENIC HEAT AND THERMAL CURRENTS IN THE EARTH'S CRUST AND MANTLE. Lyubimova, E. A.; Berzina, I. G.; Karus, E. V.; Arshavskaya, N. I. pp 209-214 of Radioaktivnye Elementy v Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Results were reported on investigations on the correlation of the surface thermal currents and the generation of heat by radioactive elements for Australian and Baltic pre-Cambrian shields and some regions of the North American continent. Some models of the distribution of the radioactive heat sources in the earth's crust were given. The results obtained led to conclusions on the relatively low generation of heat in crust zones of ancient consolidation and the high thermal potential of the upper mantle. (tr-auth)

**11992** RADIOGENIC HEAT FLOW OF THE EARTH'S CRUST OF SOUTHERN SIBERIA AND SOUTHEAST KAMCHATKA. Duchkov, A. D.; Sokolova, L. S. pp 214-216 of Radioaktivnye Elementy V Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

It was shown that the radiogenic heat is a significant part of the surface heat flow. Radiogeochemical studies made it possible to define more accurately the role of radioactive elements in the energy balance of the earth's crust. (tr-auth)

**11993** URANIUM-CARRYING CAPACITY OF UNDERGROUND WATER. Lisitsin, A. K. pp 216-223 of Radioaktivnye Elementy V Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The U-carrying capacity of underground water was analyzed as a function of its total mineralization, redox potentials, pH values, presence of dissolved $O_2$ and $H_2S$, and depth of the seam of the water-bearing level. (tr-auth)

**11994** ROLE OF THE INVESTIGATION OF THE ISOTOPIC COMPOSITION OF LEAD IN RECONSTRUCTION OF THE HISTORY OF URANIUM AND THORIUM IN ROCKS. Karpenko, S. F. pp 223-225 of Radioaktivnye Elementy V Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The necessity of taking into consideration the isotopic composition of Pb during the determination of the initial distribution of U and Th in rocks was discussed. It was shown that from the isotope data it is possible to solve such problems of geochemistry as the intensity of the metamorphic processes, sources of metals in solutions, and conditions for their deposition. (tr-auth)

**11995** ROLE OF URANIUM AND THORIUM IN THE EVOLUTION OF LEAD ORES IN CONNECTION WITH THE STUDY OF THE GENESIS OF THE ORE DESPOSITS OF THE LEAD-ZINC ORE BELT IN NORTHWEST PRIBAIKAL. Tychinskii, A. A.; Shipilov, L. D.; Perovskii, I. G.; Osipov, D. K.; Zhuravlev, R. S. pp 226-229 of Radioaktivnye Elementy V Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

Results were reported on the study of the isotopic composition of Pb in galena of stratified Pb-Zn ore deposits. Data were also given on the comparative distribution of radioactive and radiogenic elements in rocks of the upper pre-Cambrian surrounding the mineralization. It was shown that the ore material is nonhomogeneous with respect to composition. (tr-auth)

**11996** GEOCHEMICAL RELATION BETWEEN URANIUM AND TITANIUM. Kulik, N. A.; Mel'gunov, S. V.; Gavshin, V. M. pp 229-231 of Radioaktivnye Elementy V Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The coupling of the behavior of U and Ti in U-bearing sedimentary strata during progressive metamorphism and in the post-magmatic processes seems to raise a question on the existence of a geochemical relation between these elements. This can be explained by the selective absorption of U by some modifications of Ti hydroxides. The latter often occurs during the release of Ti because of the decomposition of Ti-containing rock-forming minerals during different geological processes in a wide interval of thermodynamic conditions. (auth)

**11997** GEOCHEMICALLY REASONABLE AND GEOCHEMICALLY FALSE DIRECT CORRELATIONS OF ELEMENTS. Amshinskii, N. N. pp 232-236 of Radioaktivnye Elementy V Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

On the basis of an analysis of the geochemical behavior of U in comparison with that of other elements, the relationship and polarity of elements and some geochemical singularities of the contact zone between the elements were discussed. The behavior of elements with "positive" and "negative" geochemical gradients was examined. (tr-auth)

**11998** REQUIREMENTS OF GEOCHEMISTRY IN METROLOGICAL PARAMETERS OF ANALYTICAL METHODS AND POSSIBILITIES OF THESE METHODS FOR GEOCHEMICAL STUDIES OF RADIOACTIVE ELEMENTS. Yufa, B. Ya.; Golubev, N. V.; Kuznetsov, A. G.; Gubanova, G. F. pp 237-243 of Radioaktivnye Elementy V Gornykh Porodakh. Kuznetsov, V. A.; Zhuravlev, R. S.; Osipov, D. K. (eds.). Novosibirsk, USSR; Izdatel'stvo Nauka (1975). (In Russian)

From 1st radiogeochemical congress; Novosibirsk, USSR (15 May 1972). See CONF-7205116-.

The necessity of considering metrological factors during studies of the distribution of small element concentrations was shown. The possibilities of existing methods for geochemical study of U, Ra, Th, their isotopes, and their stable decay products were discussed. The methods considered were neutron activation, isotope dilution, luminescence, x-ray spectra, and chemical methods. (tr-auth)

**11999** SOME ECONOMIC AND TECHNICAL ASPECTS OF URANIUM EXPLORATION, MINING, AND MILLING. Johnson, D. M. Paper 3.1-14, 21p. of 9th World Energy Conference. London; World Energy Conference (1974).

From 9th world energy conference; Detroit, Michigan, USA (22 Sep 1974). See CONF-740910-P3.

Although uranium is in excess supply at present, projections of future requirements indicate that new production capability from sources as yet unidentified or presently considered uneconomical will be needed by about the end of this decade. The long lead time inherent in exploration programs requires that exploration be accelerated now if these future requirements are to be met. Inferred world resources are ample to supply projected needs beyond the end of this century, but uranium prices will have to rise, both to motivate the needed exploration and to justify the development of higher cost resources. Because the cost of uranium is a relatively small component of nuclear power cost, the necessary increases in uranium prices can be tolerated with little effect on the economics of nuclear power. A number of specific economic and technical aspects of uranium exploration, mining and milling are reviewed, with particular attention to advances needed to meet the future growth in demand. (auth)

## Radioactivity Monitoring and Transport

*Refer also to abstracts 12047, 12076, 12342, and 12454.*

**12000** (BNWL-SA-5366) EXTRAPOLATION OF ANIMAL RADIONUCLIDE RETENTION DATA TO MAN: THE USE OF SIMILARITY RATIOS. Thomas, J. M.; Eberhardt, L. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1). 13p. (CONF-751126-5). Dep. NTIS $4.50.

From IAEA international symposium on biological effects of low level radiation pertinent to protection of man and his environment; Chicago, Illinois, USA (3 Nov 1975).

Since radioactive retention should be a function of metabolism it follows that direct or indirect measures could be described by a "power law" based on body weight of the organism(s). However, when such "power laws" have been extended to interspecies comparisons the resulting power coefficients are usually substantially less than the value anticipated and seem to be different for each radionuclide. We propose that interspecies comparisons ought to be based on the proportionality coefficient rather than the power parameter of the power function model and have called pairwise comparisons amongst species similarity ratios. We have examined retention data from five nonruminant species (including man) where several radionuclides with different physical properties were fed. Subsequently we devised an expression whereby an estimate of biological equilibrium level in man can be calculated using similar estimates from experiments using mice, rats, or dogs. There are some statistical questions to resolve which have to do with the assumed frequency distribution for estimates of the proportionality coefficient. In addition, we have made repeated use of the same data sets. (auth)

**12001** (BNWL-SA-5530) RAPID DIFFUSION METHOD FOR PHYSICOCHEMICAL CHARACTERIZATION OF METAL LIGANDS IN SOILS AND SEDIMENTS. Garland, T. R.; Wildung, R. E.; Pelroy, R. A. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 16p. (CONF-750985-4). Dep. NTIS $4.50.

From 15th Hanford life sciences symposium; Richland, Washington, USA (25 Sep 1975).

A diffusion method is described that allows preliminary characterization of metals in soils and sediments while minimizing the potential for alteration of metal form. In addition, examples of the application of the method to model compounds of Pu in the soil are given. (ERB)

**12002** (DP-MS-75-26) REMOVAL OF PLUTONIUM FROM DRINKING WATER BY COMMUNITY WATER TREATMENT FACILITIES. Corey, J. C.; Boni, A. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 12p. (CONF-751105-11; SM-199/81). Dep. NTIS $4.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

Plutonium removal factors (RF) averaged 14 +- 10 during a study of the effectiveness of three drinking-water treatment plants for removing Pu from Savannah River water. Plutonium concentrations between 0.1 and 3.5 femtocurie/l were measured in raw and finished water samples. From 50 to 10,000 liter samples of water were concentrated by ion exchange techniques and processed to determine the concentrations of $^{239}Pu$ and $^{240}Pu$ and to derive Pu RF's. The similarity between RF's observed for both Pu and suspended solids suggests a colloidal behavior for Pu. Plutonium RF's may be limited by low-level buildup on the treatment facility filters and subsequent bleeding into finished water, and thus may be higher during abnormal Pu releases to the environment. Flocculation and filtration appear to be the primary factors in the water treatment process contributing to Pu removal. The similarity between the plutonium contents of finished water from treatment facilities upstream and downstream of the Savannah River Plant (SRP) indicates that there is no measurable dose-to-man from SRP Pu releases in the water. The 70-year bone dose commitment to an individual from consumption for one year of 1.65 liters per day of treated Savannah River water, based on the Pu concentrations of finished waters from the three treatment facilities, is $5 \times 10^{-5}$ mrem. (auth)

**12003** (DP-MS-75-28) PLUTONIUM IN ATLANTIC COASTAL ESTUARIES IN THE SOUTHEASTERN UNITED STATES. Hayes, D. W.; LeRoy, J. H.; Cross, F. A. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 23p. (CONF-751105-10; SM-199/84). Dep. NTIS $4.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

A survey was made to begin to provide baseline information on the Pu distribution of representative estuarine and coastal areas of the southeastern United States. Sediments and marsh grass (Spartina) were collected and analyzed from three locations within a tidal marsh. In three estuaries (Savannah, Neuse, and Newport), the suspended particulate matter (1 mu m and greater) was filtered from waters with different salinities, and the plutonium content of the particulates determined. The Savannah River estuary, in addition to fallout Pu, has received up to 0.3 Ci of Pu from the Savannah River Plant (SRP) of the U. S. Energy Research and Development Administration. The SRP plutonium has a variable isotopic composition that can influence Pu isotopic ratios in the estuarine system. The other estuaries do not have nuclear installations upstream. Data are included on the content of $^{238}Pu$, $^{239}Pu$, and $^{240}Pu$ in sediments and marsh grass of the Savannah River estuary. (CH)

**12004** (DP-MS-75-30) RELATIONSHIPS AMONG PLUTONIUM CONTENTS OF SOIL, VEGETATION, AND ANIMALS COLLECTED ON AND ADJACENT TO AN INTEGRATED NUCLEAR COMPLEX IN THE HUMID SOUTHEASTERN UNITED STATES. McLendon, H. R.; Stewart, O. M.; Boni, A. L.; Corey, J. C.; McLeod, K. W.; Pinder, J. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 23p. (CONF-751105-13; SM-199/85). Dep. NTIS $4.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

Twenty-three representative sampling locations in and adjacent to the Savannah River Plant (SRP) site were selected to obtain information on Pu movement in the food chain under southeastern U. S. environmental conditions. Soil, a resuspendible fraction of the soil, honeysuckle (Lonicera japonica), and camphor weed (Heterotheca subaxillaris) were collected at each location. Grasshoppers and cotton rats (Sigmodon hispidus) were collected at some locations. The soil concentrations at the selected locations ranged from 1.5 fCi/g to 171 fCi/g, and alpha percentages of

$^{238}$Pu ranged from 2 to 66. The concentration of plutonium in the vegetation and on the leaves ranged from 0.17 to 76.1 fCi/g, and the alpha percentages of $^{238}$Pu, from 3 to 61. The concentration of plutonium in cotton rats and grasshoppers ranged from 0.07 to 3.58 fCi/g, and the alpha percentages of $^{238}$Pu ranged from 22 to 80. Comparisons among the Pu values of the vegetation, soil, and resuspendible fractions suggest the use of a proposed resuspendible measurement technique as a monitoring method to indicate subtle changes in the Pu concentration of the soil surface that are not detectable by routine soil sampling. Although the $^{238}$Pu data in the various ecosystem components were not conclusive, they support evidence that there is an apparent increase in the biological availability of $^{238}$Pu relative to the $^{239,240}$Pu in the environment. The Pu concentrations of ecosystem components decreased as the distance from the reprocessing plants increased. (auth)

**12005** (EGG-1183-1632) RADIOLOGICAL SURVEY OF THE AREA SURROUNDING THE NATIONAL REACTOR TESTING STATION, IDAHO FALLS, IDAHO. Date of Survey: 1 and 2 February 1972. (EG and G, Inc., Las Vegas, Nev. (USA)). 4 Jun 1974. Contract AT(29-1)-1183. 21p. Dep. NTIS $4.00.

The Aerial Radiological Measuring System (ARMS) was used to survey the National Reactor Testing Station (NRTS) during February 1972. The purpose of the survey was primarily to identify the presence of Ru-106 and Rh-106 in a release from the Chemical Processing Plant at NRTS. Additionally, the gamma-ray terrestrial exposure rate levels were mapped and the distribution of any man-made isotopes was located and defined. (auth)

**12006** (NVO-269-26) BIOENVIRONMENTAL STUDIES, AMCHITKA ISLAND, ALASKA, 1975 TASK FORCE REPORT. Nelson, V. A. (Comp.). (Washington Univ., Seattle (USA). Coll. of Fisheries). Dec 1975. Contract E(26-1)-269. 20p. Dep. NTIS $4.50.

Bioenvironmental studies at Amchitka Island, Alaska, have been sponsored by the Atomic Energy Commission-Nevada Operations Office (now U. S. Energy Research and Development Administration-Nevada Operations Office) since 1967 when the Island was selected as the site for two underground nuclear weapons tests, Milrow in October 1969, and Cannikin in November 1971. Limited bioenvironmental studies were also conducted for the Department of Defense test, Long Shot, in October 1965. Initially, the studies focused on predictions of test effects, recommendations to minimize possible adverse effects, and base line measurements to aid in evaluating the actual effects. After the Cannikin test, the studies focused on the measurement and evaluation of these effects. This report presents the findings of a field survey on Amchitka during the period of 8 August through September 9, 1975. A background radiation survey conducted on the Island revealed that levels of radioactivity on Amchitka remain comparable to levels in other areas of the United States. Samples of plants, animals, soil and water were also collected for radiometric analyses in the home laboratory. Results of the tritium analyses of the water samples (excepting those from the Long Shot area) indicated that $^{3}$H values are what would be expected at an island station at a similar latitude in the northern hemisphere. The Long Shot mud pits and their drainage system remain contaminated with $^{3}$H. The $^{3}$H concentration is less than in the rainfall at Vienna, Austria, in 1963. Results of the other radiometric analyses will be reported later. The spawning run of pink salmon was surveyed in 20 streams. The 16 to 19 salmon counted in 1975 was greater than the 5 counted in the brood year, 1973, but was still appreciably lower than the 100 fish estimated for 1971. The disturbed areas reseeded in 1973 with Boreal creeping red fescue, high-light chewings fescue, Bering hairgrass, and annual ryegrass exhibited good growth of the fescue and hairgrass emerging through a dense mulch of dead ryegrass stems and leaves from the first two seasons of growth. The fungus discovered growing in some of the reseeded areas in 1974 was identified as Corticium fuciforme. The fungus was not found on native vegetation adjacent to the plots. (auth)

**12007** (ORO-4700-2) ADSORPTION AND DIFFUSION OF Pu IN SOILS. Progress Report, April 1, 1975–December 1975. Brown, D. A. (Arkansas Univ., Fayetteville (USA)). 1975. Contract AT(40-1)-4700. 18p. Dep. NTIS $4.50.

Adsorption, desorption, and diffusion coefficients of $^{238}$Pu were determined for three contrasting soils, Fuquay sand, Hanford sandy loam, and Muscatine silt loam. Aqueous diffusion of $^{238}$Pu was determined for solutions of nitric acid, and calcium and cerium nitrate salt solutions. (auth)

**12008** (PB-237796) PRELIMINARY LABORATORY RESEARCH IN EXPERIMENTAL BRACKISH ECOSYSTEMS. Lacaze, J. C.; Hallopeau, C.; Voight, M. Translated from Bull. Mus. Natl. Hist. Nat.; 41: No. 5, 1278-1289(1969). 16p. (EPA-TR-58-75). NTIS $3.25.

The report presents the effects that radioactive and chemical pollution have on the biology of experimental marine ecosystems. It describes the first study made to establish the broad outlines of the evolution of several brackish ecosystems under experimental conditions. The results will enable the selection of some points of the biology of these ecosystems that would be of special interest for future pollution studies. (auth)

**12009** (SAAS-183) ECOLOGY OF RADIUM. A Literature Survey. Clajus, P. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Aug 1975. 29p. (In German). Dep. NTIS (US Sales Only) $4.00.

The literature dealing with the diffusion of radium in the ecosystem is reviewed up to 1971. For the food chain of rock–soil–water–plant–animal, radium concentrations and transfer factors are listed. Due to the considerable fluctuations of these values an evaluation of population ingestion doses cannot be made. (auth)

**12010** OPTIMIZING THE CONTROL OF RADIOACTIVE CONTAMINATION IN INDUSTRIAL ENTERPRISES. Zaraev, O. M.; Rakhmanov, B. N.; Malyumin, S. V. (All-Union Central Scientific Research Inst. of Labor Protection, Moscow). Gig. Sanit.; No. 6, 28-33(1975). (In Russian)

The researchers developed a work classification according to danger from (a) potential radioactive contamination accidents; (b) constant radioactivity from normal plant operation; and (c) small radioactive leaks. For (a) in an accident, checks of skin covering and nose cavities may be necessary. In (b) air samples for a long period of time are indicated. With (c) an aerosol control is necessary in many places in the work area. Areas of radioactive danger are divided into those without much danger, those with danger, and those very dangerous. The programs and controls for each plant area depend greatly upon the special circumstances of the particular area. Radiation levels are specified and the distribution of radioactive aerosol contamination is described by a logarithmically normal law. An ideal schematic plan of optimum control of radioactive contamination in a nuclear power plant is presented. (JPRS)

## Atmosphere

*Refer also to abstracts 11943, 12070, 12072, 12074, and 13453.*

**12011** (BARC-808) FISSION AND ACTIVATION PRODUCT DATA RELEVANT TO THE STUDIES ON RADIOACTIVE FALLOUT FROM ATMOSPHERIC NUCLEAR EXPLOSIONS. Mishra, U. C.; Shukla, V. K.; Ramachandran, T. V. (Bhabha Atomic Research Centre, Bombay (India)). 1975. 42p. Dep. NTIS (US Sales Only) $5.00.

Studies on radioactive fallout from nuclear weapon tests carried out in the atmosphere have been employed for a number of applications e.g., atmospheric circulation studies using fallout as a tracer, external radiation dose from depositions on global scale, weapon information, etc. In addition these studies can be used for estimating future likely external gamma dose to the population at large by properly extrapolating the information available for the current depositions. These studies require latest information about radioactive properties of various fission products and other radioactive isotopes produced in nuclear explosions, fission yields, production ratios, and induced radionuclides. An attempt was made to summarize available information about all these aspects. (auth)

**12012** (BNWL-B-429) ENVIRONMENTAL STATUS OF THE HANFORD RESERVATION FOR CY-1974. Fix, J. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Sep 1975. Contract E(45-1)-1830. 63p. Dep. NTIS $5.45.

Environmental data collected at the Hanford Reservation during 1974 showed continued compliance of Hanford operations with all applicable State and Federal regulations. Data are presented on levels of radioactivity in samples of surface air, drinking water, Columbia River water and other surface waters, soil, and tissues of wild animals and water fowl collected at various locations. (CH)

**12013** (CONF-750827--, pp 15-17) RADIOLOGICAL SURVEILLANCE OF ERDA EXCESS REAL PROPERTY. Allen, R.E. (Energy Research and Development Administration, Washington, DC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The problems associated with the resurvey of the radiological condition of previously excessed real property that was associated with radioactivity are discussed and guidance toward expediting future decontamination and disposition actions of real property

currently considered as excess to ERDA program needs is provided. (LK)

**12014** (COO-1407-58) RAIN SCAVENGING STUDIES. Progress Report No. 11. Dingle, A. N. (Michigan Univ., Ann Arbor (USA). Dept. of Atmospheric and Oceanic Science). May 1975. Contract AT(11-1)-1407. 85p. Dep. NTIS $6.00.

The modeling of convective storm scavenging processes is going forward on two distinct fronts. The first of these relates to the microphysical processes, particularly to the study of their response to micro-dynamical components of the convective circulation. It is found that the droplet size spectra generated are responsive to variations of vertical velocity due to turbulence within the cloud and to humidity variations due to entrainment processes. Both sets of variations give responses that differ for different amplitudes and frequencies, i.e., rapid, small-amplitude eddies appear to enhance small-droplet development, whereas slow, large-amplitude oscillations tend to enhance large-droplet development. An allied study of the assumptions used in the microphysical equations is also being made. The second modeling effort is addressed to the problem of three-dimensional representation of convective dynamics. Equations are presented, and some of the problems under attack are discussed. (auth)

**12015** (COO-2736-1) POLLEN AND SPORES AS VECTORS OF RADIONUCLIDE PARTICLES AT THE ROCKY FLATS FACILITY, COLORADO. First Progress Report, July 1975–14 October 1975. Nichols, H.; Nichols, M. (Colorado Univ., Boulder (USA)). 15 Oct 1975. Contract E(11-1)-2736. 18p. Dep. NTIS $4.50.

Preliminary results are reported from a study on possibility of pollen and micro-spores as vectors of radionuclide particles at the Rocky Flats Facility, Colorado. It was found that the air samplers in use at Rocky Flats are not efficient for sampling large (50 to 100 micron) pollen particles. No large radionuclide particles were found attached to pollen. (CH)

**12016** (FFIF-F-614) CESIUM-137 IN NORWEGIAN MILK, 1960–1974. Hvinden, T. (Forsvarets Forskningsinstitutt, Kjeller (Norway)). Jun 1975. 15p. Dep. NTIS (US Sales Only) $3.50.

Cesium-137 in milk was measured at 11 sampling sites in Norway since 1960. The results show seasonal variations, normally with a peak during summer, and variations from district to district, depending upon precipitation and farming conditions. The concentration of cesium-137, averaged over all sampling sites, reached a maximum of 0.44 nanocurie/liter in 1964, decreasing to 0.06 in 1974. (auth)

**12017** (GAT-R-589) AIR SAMPLING PROGRAM AT THE PORTSMOUTH GASEOUS DIFFUSION PLANT. Hulett, S. H. (Goodyear Atomic Corp., Piketon, Ohio (USA)). 1 Dec 1975. Contract E(33-2)-1. 12p. (CONF-760202-1). Dep. NTIS $4.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

An extensive air sampling program has been developed at the Portsmouth Gaseous Diffusion Plant for monitoring the concentrations of radioactive aerosols present in the atmosphere on plantsite as well as in the environs. The program is designed to minimize exposures of employees and the environment to airborne radioactive particulates. Five different air sampling systems, utilizing either filtration or impaction, are employed for measuring airborne alpha and beta-gamma activity produced from $^{235}U$ and $^{234}Th$, respectively. Two of the systems have particle selection capabilities: a personal sampler with a 10-mm nylon cyclone eliminates most particles larger than about 10 microns in diameter; and an Annular Kinetic Impactor collects particulates greater than 0.4 microns in diameter which have a density greater than 12-15 gm/cm$^3$. A Hi-Volume Air Sampler and an Eberline Model AIM-3 Scintillation Air Monitor are used in collecting short-term samples for assessing compliance with "ceiling" standards or peak concentration limits. A film-sort aperture IBM card system is utilized for continuous 8-hour samples. This sampling program has proven to be both practical and effective for assuring accurate monitoring of the airborne activity associated with plant operations. (auth)

**12018** (HASL-298, pp I.2-I.6) CONTINUOUS MONITORING OF URBAN RADON-222 CONCENTRATIONS. Thomas, J. W.; Fisenne, I. M. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1–December 1, 1975. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.).

An environmental radon monitor (ERM-2) has been used to continuously measure variations in radon-222 concentration in New York City. The average ground level concentration was found to be about 100 pCi/m$^3$, with very little diurnal variation. (auth)

**12019** (HASL-298, pp I.7-I.30) RADIOACTIVITY DISTRIBUTION IN THE STRATOSPHERE FROM THE CHINESE HIGH YIELD NUCLEAR TEST OF JUNE 27, 1973. Telegadas, K. (Air Resources Labs., Silver Spring, MD). 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1–December 1, 1975. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.).

Radioactivity concentrations and ratios in stratospheric air samples up to about 30 km describe the latitudinal and vertical spread of debris from a stratospheric source. China detonated a nuclear device, which was reported to have a total yield of 2 to 3 MT, at 40$^0$N, 90$^0$E on June 27, 1973. An estimate of the initial source distribution for this test and the depletion of the resulting stratospheric burden is discussed. Comparisons are made between this event and the four earlier high yield nuclear tests conducted by China, each of which was reported to have a total yield of 3 MT. (auth)

**12020** (HASL-298, pp I.31-I.62) HASL SURFACE AIR SAMPLING PROGRAM. The Quality of Analysis, 1974. Toonkel, L.; Schonberg, M.; Volchok, H. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1–December 1, 1975. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.).

The Surface Air Sampling Program systematically samples and analyzes the particulate matter in surface air for various radioactive ($^{90}Sr$, $^{210}Pb$, $^{7}Be$, $^{95}Zr$, $^{137}Cs$, $^{144}Ce$, and $^{239}Pu$) components and for stable lead. In general the quality of the analyses in the Surface Air Sampling Program in 1974 was satisfactory. The accuracy averaged within 15 percent and the mean precision was within +- 15 percent in most cases. There was a continued tendency toward a negative bias for a number of the substances analyzed. (auth)

**12021** (HASL-298, pp I.63-I.82) GLOBAL VARIATION OF LEAD-210 IN SURFACE AIR AND PRECIPITATION. Rangarajan, C.; Gopolakrishnan, S.; Eapen, C. D. (Bhabha Atomic Research Centre, Bombay). 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1–December 1, 1975. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.).

The average activity levels of $^{210}Pb$ in surface air and precipitation at 105 locations (66 in the northern hemisphere and 39 in the southern hemisphere) are presented. These values have been extracted from data available in literature up to the end of 1974. The values have been tabulated along with the associated data like period of measurements, frequency of sampling, etc. The levels are also shown in graphs. Some of the basic features of the global variation of $^{210}Pb$ are discussed briefly. (auth)

**12022** (HASL-298, pp II.1-II.6) HASL FALLOUT PROGRAM DATA. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1–December 1, 1975. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.).

Data are presented on the content of fallout $^{90}Sr$ in samples of atmospheric precipitations collected during 1975 at various world land sites, in samples of drinking water, milk, human diet, and human bones collected in New York City, in samples of human diet and bones collected in San Francisco, and in samples of human bones from countries where western-type diets are not typical. (CH)

**12023** (HASL-298, pp III.2-III.48) ENVIRONMENTAL RADIOACTIVITY ANNUAL REPORT, 1974. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1–December 1, 1975. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.).

Data are presented on levels of radioactivity in samples collected in New Zealand during 1973 and 1974. Data are included on gross beta activity of air and rainwater samples; the content of $^{90}Sr$ in samples of rainwater, milk, and human bone; the content of $^{137}Cs$ in samples of milk, and the content of $^{226}Ra$ and $^{210}Pb$ in samples of human bone. (CH)

**12024** (JAERI-M-5957) STUDIES ON THE METHODS OF ENVIRONMENTAL RADIATION MONITORING. Kadokawa, M. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 189p. (In Japanese). INIS.

The methods of environmental monitoring are theoretically discussed, with the experiences reported of reactor accidents and the data of a fission product release test. First, the data of background environmental radiation and radioactivities around the JAERI site are statistically analyzed from a viewpoint of geophysics, and the distribution of gamma-exposure rates is calculated in connection with the radioactive cloud from a nuclear reactor. Then, the allowable limits of gaseous radioactivities and the alarm level of an environmental monitoring system are discussed. Next, the design of an environmental monitoring system for the radiological disasters due to reactor accidents is

discussed, based on the principles described in the previous report, JAERI-1193; but, different assumptions are made of the F. P. cloud concentration and the magnitude of radiological disaster. And detail discussions are made especially on the effect of sky-shine phenomena. Finally, the method of estimating rapidly the distributions of wide-spread radioactive contamination from observed data with the monitoring network, in a reactor accident, is described. The data of SL-1 accident and the F. P. field release test at NRTS in 1958, are found to be consistent with the author's theory. (auth)

**12025** (JUL-1101-ST) HEALTH PHYSICS DIVISION ANNUAL PROGRESS REPORT, 1973. Keller, M.; Tzschaschel, R. (eds.). (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Zentralabteilung Strahlenschutz). Aug 1974. 271p. (In German). Dep. NTIS (US Sales Only) $10.00.

The Health Physics Division has the responsibility for adequate radiation protection of installations, personnel, and the environment. This includes the introduction of required organizational procedures and the adaptation of methods to the latest scientific and technical knowledge. The service and research activities done in these areas are reported. The monitoring of the installations, the results obtained, and the evaluation of the data obtained are described. In the area of personnel monitoring the results obtained in the measurement of external radiation burdens are given graphically. Special studies made on a critical comparison of film and rod dosimeter monitoring, development of thermoluminescence dosimeters of LiF in teflon, and machine bookkeeping of thermoluminescence dosimeter results are described in detail. In the area of environmental protection the results of the environmental monitoring and measurement of radioactive emissions at Juelich are summarized and tabulated. Meterological measurements are reported. The operation of the library services is discussed, including data processing. The results obtained in a study of the propagation of harmful materials in the atmosphere and the radiation burden are described. Research in the area of developing radiation protection methods included a study of spherical moderator dosimeters, determination of the equivalent dose of high-energy neutrons with fission fragment dosimeters, automatic detection of fast neutron tracks by non-photographic methods, radiochemical method for the determination of $\alpha$ emitters in the urine, medically induced elimination of $^{113m}$In, fading of dosimeter film, and errors in the calibration curve evaluation of dosimeter film. (JSR)

**12026** (KFK-2189) WOLGA 1: A FORTRAN IV PROGRAM FOR CALCULATION OF THE GAMMA DOSE RATE FROM RADIOACTIVE EFFLUENT AIR RELEASED BY ONE OR SEVERAL CONTINUOUSLY EMITTING SOURCES. Nagel, D.; Papadopoulos, D. (Kernforschungszentrum Karlsruhe (F.R. Germany). Abt. Strahlenschutz und Sicherheit). Oct 1975. 21p. (In German). Dep. NTIS (US Sales Only) $3.50.

The WOLGA 1 computer program serves to calculate the dose rate in the vicinity of one or several emitters continuously releasing $\gamma$ active effluent gases. Frequency distributions must be available of the directions of propagation, wind velocities, and diffusion categories. The program is also used to calculate the annual impact on the environment by $\gamma$ active emissions from the reactors of the Karlsruhe Nuclear Research Center. This task must be solved again every year due to the occasional addition of new emitters and the change in the source strengths, the nuclide mixtures, and the meteorological conditions. The computer program must take into account such changes without difficulties. The program calculates for any field point the $\gamma$ dose rate of the cloud of effluent air from one or several emitters. The possibility exists of establishing a list of dose rates applicable to selected field points (e.g. villages) as well as an isodose chart for predetermined dose limits. Program input and output are explained with an example. (auth)

**12027** (NP-20532) DIFFUSION OF RADIOACTIVE GASES IN THE MESO-SCALE (20 km-400 km). Wippermann, F. (Commission of the European Communities, Brussels (Belgium)). 15 Feb 1974. 42p. Dep. NTIS (US Sales Only) $5.25.

The term "Mesoscale" refers to distances between 20 km and 400 km from the source; in defining this range, the structure of atmospheric turbulence is taken into account. To arrive at an evaluation of diffusion in the mesoscale, quantitative methods from the microscale (source distance < 20 km) and qualitative methods from the macroscale (source distance > 400 km) are extrapolated into the mesoscale. In the first case a table is given to read off the minimum factor by which the concentration is reduced in the mesoscale as the source distance increases; to obtain the diffusion for the worst possible case, the existence of a mixing-layer topped by a temperature inversion was assumed. For this it was essential, first of all, to determine the source distance $x_D$ beyond which the diffusing gases are completely mixed within the mixing-layer of thickness D. To make allowance for all possible thicknesses of this mixing-layer, a measurement carried out at ground level at only 10 km from the source can be used to calculate the correct concentrations in the mixing-layer; the dilution factors will then be related to this value. Possible ways of an improved incorporation of certain factors in the diffusion estimate, such as the topography of the earth's surface, the roughness of terrain, the vertical profiles of wind and exchange coefficients and the effects of non-stability are given in the last section. (auth)

**12028** (PNE-RB-63(Add.)) PROJECT RIO BLANCO RADIOACTIVITY AND THE ENVIRONMENT. (CER Geonuclear Corp., Las Vegas, Nev. (USA)). Oct 1975. 36p. Dep. NTIS $5.00.

Data are presented on radiological measurements of the environment and on documenting the transfer to a subsurface disposal well of radioactive water separated from the produced gas stream. Analysis of gas and water through the drilling well control unit revealed the presence of $^{3}$H and $^{85}$Kr in the gas and $^{3}$H, $^{137}$Cs, and $^{90}$Sr in the water. The production test, disposal system, and radiological monitoring system are described. Data on effluents are presented under the headings: gas and water production, radioactivity concentrations in gas, radioactivity concentrations in separator water samples, radioactivity concentrations in injected water volumes, and disposition of radioactivity. Tritium, $^{39}$Ar, $^{14}$C, $^{85}$Kr, and $^{222}$Rn were present in gas. Tritium, $^{134}$Cs, $^{137}$Cs, $^{90}$Sr, $^{75}$Se, and $^{106}$Ru were present in separator water samples. Data on environmental monitoring and RB-AR-2 drilling and testing are presented under the headings air sampling, air moisture and precipitation sampling, soil sampling, water sampling, Fawn Creek sediments and algae/moss samples, bioassays, aerial surveillance, and potential environmental radiation doses. (HLW)

**12029** (SAAS-184) INTEGRAL POPULATION DOSES DUE TO OFF-GASES FROM NUCLEAR POWER STATIONS. Krueger, F. W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Aug 1975. 12p. (In German). Dep. NTIS (US Sales Only) $3.50.

Methods for calculation of population doses due to atmospheric releases of radionuclides during normal operation of nuclear power stations are discussed. If the results are to be compared with biologically founded dose limits, it is inadmissible to stop integration in a certain distance from the source or at a certain dose rate because of the considerable contributions to the dose integral provided even by medium-lived nuclides at great distances and at low dose rates, respectively. Furthermore under certain conditions the permissible releases from a nuclear power station may be determined by the requirement to observe the integral population dose values. Because the population doses in small countries may be caused to a substantial degree by sources situated abroad, an international agreement of dose limits should be reached as soon as possible, even if the said releases are still too small for the present to entail a risk of deleterious effects. (auth)

**12030** (SCPRI(RM)-2-1975) MONTHLY PROGRESS REPORT. (Service Central de Protection Contre les Rayonnements Ionisants, 78-Le Vesinet (France)). Feb 1975. 11p. (In French). INIS.

This monthly report of the SCPRI exposes an interpretation of the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), seawater around nuclear plant sites and other sites. The activities of various radioisotopes are presented in tables ($^{7}$Be, $^{95}$Zr and $^{95}$Nb, $^{103}$Ru, $^{131}$I, $^{137}$Cs, $^{140}$Ba and $^{140}$La, $^{90}$Sr, $^{106}$Ru and $^{106}$Rh, $^{226}$Ra, $^{54}$Mn, U, and T). A monthly bibliographic selection is also presented. (FR)

**12031** (UCRL-77520) ATMOSPHERIC RELEASE ADVISORY CAPABILITY (ARAC). Dickerson, M. H. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Nov 1975. Contract W-7405-Eng-48. 7p. (CONF-751155-1). Dep. NTIS $4.50.

From IEEE nuclear power systems symposium; San Francisco, California, USA (19 Nov 1975).

The chief purpose of ARAC data acquisition program is to provide site officials, who are responsible for ensuring maximum health protection for the endangered site personnel and public, with estimates of the effects of atmospheric releases of hazardous material as rapidly and accurately as possible. ARAC is in the initial stages of being implemented and is therefore susceptible to changes before it reaches its final form. However the concept of ARAC is fully developed and was successfully demonstrated during a feasibility study conducted in June 1974, as a joint effort between the Savannah River Laboratory (SRL) and Lawrence Livermore Laboratory (LLL). Additional tests between SRL and LLL

are scheduled for December 1975. While the immediate goal is the application of ARAC to assist a limited number of ERDA sites, the system is designed with sufficient flexibility to permit expanding the service to a large number of sites. Success in ARAC application should provide nuclear facilities with a means to handle better the urgent questions concerning the potential accidental hazards from atmospheric releases in addition to providing the sites with a capability to assess the effort of their normal operations. (CH)

**12032** ELIMINATION OF PERIODIC COMPONENT IN ANALYSIS OF RADIOACTIVE AEROSOL CONCENTRATION MEASUREMENTS. Patich, D.; Smilyanich, R. (Boris Kidric Inst., Vinca, Yugoslavia). Gig. Sanit.; No. 4, 84-88(Apr 1975). (In Russian)

To eliminate the daily periodic component in formulating the time sequence, randomly deviating values in the same part of the cycle are excluded. Results showed that between the temperature gradient and the natural radioactive aerosol concentration there is a correlation with a 4-hr phase displacement. The method is suitable for use in inversion conditions but not in transient or convection conditions. (TTT)

**12033** RADIOACTIVITY IN THAILAND. Bhodigen, S. J. Natl. Res. Counc. Thailand; 7: No. 1/2/3/4, 24-30(Dec 1975). (In Thai)

In order to check the presence of radioactivity in Thailand, radioactivity of soil, plant, water, and air was measured. It is found that soil, plant, and water have normal level of radioactivity compared with those measured in other countries. Analysis of rain water and air indicates that since air masses coming into Thailand from the north or north-east usually blow out of Siberia, Thailand will receive fallout from nuclear weapons test in Siberia in the winter time. (auth)

**12034** MUTAGENIC EFFECTS OF IONIZING RADIATION ON CHEMICAL MATERIALS. Sobels, F. H. (Rijksuniversiteit Leiden (Netherlands). Lab. voor Stralengenetica en Chemische Mutagenese). Atoomenerg. Haar Toepass.; 17: No. 9, 188-193 (Sep 1975). (In Dutch)

From symposium on the effects of use of nuclear and fossil energy sources with regard to health and environment; Utrecht, The Netherlands (4 May 1975).

It is estimated that the mean annual dosage due to natural radiation was 100 mrem in 1970, and that this would be increased by only 1% if all electricity were produced by nuclear power stations. This would lead to a very small increase in disease and mutations due to dominant, recessive and chromosome traits, but possibly to a growing increase in congenital mutations. Atmospheric sulphur dioxide leads to formation of uracil and cytosine; atmospheric oxides of nitrogen lead to mutations of the Salmonella bacteria, and both cause plant mutations, which have been studied in detail for Tradescantia. Incomplete combustion of fossil fuels leads to carcinogens such as polycyclic hydrocarbons (benzanthracenes, benzpyrenes, etc). There is no evidence that nuclear power stations will lead to greater health risks than the present stations. (NL)

**12035** EFFECTS OF NUCLEAR ENERGY PRODUCTION ON HEALTH AND ENVIRONMENT. Davids, J. A. G. (Stichting Reactor Centrum Nederland, The Hague). Atoomenerg. Haar Toepass.; 17: No. 9, 194-199(Sep 1975). (In Dutch)

From symposium on the effects of use of nuclear and fossil energy sources with regard to health and environment; Utrecht, The Netherlands (4 May 1975).

An account is given of precautions recommended and taken in order to reduce the danger of ill-effects to human beings resulting from radiation. Upper limits are given for tritium and for radioactive nuclides of ruthenium, caesium, strontium, radium and plutonium. The general case is for as great a reduction as possible of all radioactive products that can have harmful effects. (NL)

**12036** EVALUATION OF RADON AND ITS DAUGHTER PRODUCTS CONCENTRATION IN THE AIR USING TRIACETATE CELLULOSE FOILS. Domanski, T.; Chruscielewski, W.; Liniecki, J. (Inst. of Occupational Medicine, Lodz, Poland). Nukleonika; 20: No. 6, 589-600(1975).

Triacetate cellulose foils were used for determination of Rn or potential $\alpha$ energy concentration in the air. This study has shown that under applied conditions of the chemical processing of the foil the $\alpha$ track density after exposure to a constant number of $\alpha$ particles was independent of temperature, humidity and moderate dust coverage. No fading of the response was observed over 12 days' interval between the exposure and development. The response of TAC foil to cumulated potential $\alpha$ energy concentration (WLh) varied with changes in the radioactive equilibrium between radon and its daughter products in a theoretically predicted manner. For estimation of (WLh) a combined method is proposed, consisting of continuous monitoring by means of TAC foil and periodic determination of the average ratio Rn conc.: WL conc. in the mining environment. (auth)

## Soil

*Refer also to abstracts 11954, 12685, and 12688.*

**12037** RADIONUCLIDE MIGRATION AS A FUNCTION OF THE QUALITY OF IRRIGATION WATER. Saas, A.; Grauby, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13—Saint-Paul-les-Durance (France). Dept. de Protection). C. R. Hebd. Seances Acad. Agric. Fr.; 60: No. 5, 1181-1192(1974). (In French).

The depth migration of radionuclides ($^{137}$Cs, $^{54}$Mn, $^{60}$Co) and their different chemical forms available as a function of the quality of the irrigation water were investigated in two types of soils. The notion of irrigation water quality should be introduced in order to assess the potential radioactive contamination of soils. (FR)

## Water

*Refer also to abstract 11993.*

**12038** WATER QUALITY INSTRUMENTATION. Volume 1. Selected Papers From International Symposia Presented by the Instrument Society of America. Scales, J. W. (ed.). Pittsburgh; Instrument Society of America (1974). 208p.

Sixteen papers are included on advances in measurement and control technology for water pollution. One item was separately abstracted. Other subjects include ion selective electrodes, telemetry, and total carbon analysis. (PCS)

*For abstracts of individual papers see: 12039.*

**12039** USE OF FIELD INSTRUMENTS IN THE OPERATION OF ENVIRONMENTAL SURVEYS AROUND NUCLEAR POWER PLANTS. Plato, P. A.; Gelskey, D. E. (Univ. of Michigan, Ann Arbor). pp 176-183 of Water Quality Instrumentation. Vol. 1. Scales, J. W. (ed.). Pittsburgh; Instrument Society of America (1974).

An underwater gamma radiation probe was constructed to provide qualitative and quantitative measurements while traveling over bottom sediments. The underwater probe was used at two nuclear power plant sites to determine preoperational levels of radioactivity present in the sediments near the plants. Contour lines of gross gamma activity and the naturally occurring radionuclide potassium-40 were drawn to identify areas of relatively high and low activities. (auth)

**12040** DETERMINATION OF LOW $^{226}$Ra ACTIVITIES IN WATER. Sladkova, M.; Abel, E.; Ivan, J. (Vyskumny Ustav Hygieny, Bratislava (Czechoslovakia)); Chrapan, J.; Oravec, J.; Holy, K. (Komenskeho Univerzita, Bratislava (Czechoslovakia). Prirodovedecka Fakulta). Cesk. Hyg.; 19: No. 10, 480-484(Dec 1974). (In Slovak).

Low $^{226}$Ra activities in water were determined directly by the separation method of a concurrent precipitation of radium with barium sulfate and lead sulfate and indirectly using the decay product $^{222}$Rn. Activity was measured by low-background flow counter Biospan, model 4336 of Nuclear Chicago in the proportional area. For the latter way of measuring, a large-volume planoparallel corona counter was designed, suitable for measuring $^{222}$Rn activity. The characteristics of both counters are described. The minimum measurable activity was of the order $10^{-3}$ s$^{-1}$. (auth)

**12041** MEDITERRANEAN AS A SYSTEM. II. Small Ecosystems. Onuf, C. P. (Univ. of California, Santa Barbara); Murdoch, W. W. Int. J. Environ. Stud.; 6: No. 1, 29-34(Mar 1974).

The coastal zone of the Mediterranean was studied for pollution effects. Toxic wastes—heavy metals, PCBs, acids, radioactivity, oil, pesticides, and organic pollutants are discussed. In small amounts, organic pollution increases productivity by stimulating the growth of a few species at the expense of others. If it becomes too severe, biological production rises so that its decomposition consumes all the available $O_2$. Since Mediterranean coastal waters are relatively unproductive, communicate freely with the open sea, and the continental shelf is generally quite narrow, the waters can take a relatively high load. River systems such as the Ebro, Rhone, Po, and Nile are discussed. Major potential users and possible polluters include tourism, fisheries, industrial development, mineral extraction, and shipping. Most of the sewage around the Mediterranean passes raw into the ocean. Effects and extent of pollution need to be measured for rational management of the coastal waters. (Pollut. Abstr.)

### Ecosystems and Food Cycles

*Refer also to abstract 12458.*

**12042** STUDY OF THE MANGANESE-54 UPTAKE BY PLATYHYPNIDIUM RIPARIOIDES (HEDW.). Hebrard, J. P. (Aix-Marseille-3 Univ., 13 - Marseille (France)); Foulquier, L. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Service de Recherches Toxicologiques et Ecologiques). Rev. Bryol. Lichenol.; 4: No. 1, 35-54(1975). (In French)

The experimental conditions are described and the different experiments conducted are presented. First of all the behavior of manganese-54 in the experiment tanks is studied. In a tank containing only water, more than 50% of the manganese is absorbed by the walls. In a tank with a layer of sediment at the bottom, one notes the rapid fixation of manganese-54 by the sediment. After 14 days the water loses more than 90% of the radioactive element. The fixation capability of Manganese-54 by Platyhypnidium is great. In the presence of water labeled with this element, one gets a concentration factor of 40 in 60 minutes. When contaminated mosses are left in water untouched for 42 days, the desorption of manganese-54 is only 17%. If the contaminated mosses are placed in the presence of sediment, the quantity of manganese-54 available to the plants is much smaller. Nevertheless, the concentration factors may be greater than 1000, since the water is rapidly deactivated. Under such experimental conditions the desorption of manganese-54 by the mosses is quite apparent. Part of the radioactive element is very slightly retained by the plant, which corresponds to a very short biological period of about 2 days; another part of the radioactive nuclide is solidly retained for a long time. The possibility of direct uptake of manganese-54 by the plant from the sediment is practically nil. Another series of experiments provides more precise confirmation of the indications concerning the degree of fixation of manganese-54 by mosses, and the distribution of the radioactive element among the various components of the aquaria as a function of the biomass and the degree of overlapping. These data lead to suggest the use of the Platyhypnidium as indicators of the radioactive pollution of the medium by manganese-54. (FR)

**12043** BEHAVIOR OF STRONTIUM AND CESIUM RADIOISOTOPES IN MODEL BIOGEOCENOSES. Gegamyan, G. V. (Inst. of Medical Radiology, Obninsk, USSR). Ekologiya; No. 6, 90-94(Nov 1974). (In Russian).

An attempt is made to investigate the behavior of Sr-90 and Cs-137 under conditions imitating the natural setting with the purpose of determining the migration characteristics of these isotopes in biogeocenoses in the presence and absence of plant cover. A study was also made of the effect of mosses on the behavior of Sr-90 and Cs-137. The experimental results showed that a grass cover has a noticeable effect on the behavior of both radioisotopes in the soil. It is shown that Cs-137 is much slower than Sr-90 on being incorporated into the biological cycling of elements. A study of the role of moss cover showed that mosses have a greater effect on the migration of strontium and cesium radioisotopes in the soil than the higher plants. In this case both radionuclides are accumulated to a significant degree in the aboveground mass of the green mosses. Moss cover also has an effect on the migration of Cs-137 in the soil. (INIS)

## Radiometric Techniques

*Refer also to abstracts 11420, 11452, 11453, 11518, 12018, 12020, 12070, 12158, 12161, and 12529.*

**12044** (CONF-7209130-, pp 197-225) SOME ISOTOPIC ASPECTS OF THE CYCLE OF NATURAL WATERS. Fontes, J. C. (Univ., Paris). 1972. (In French)

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

In the hydrosphere the primary cause of isotopic fractionation is a partial phase change as condensation from a mass of vapor or evaporation from a liquid. The notations used, the thermal dependence of the fractionation, and the standards for oxygen isotopes are reviewed. The interdependence of $^{18}O-D$ in natural waters is stressed. Three typical problems in the isotopic tracking of natural waters are drawn from the literature. The problem itself is described, the techniques adopted to solve it, and the results obtained are reviewed and critically evaluated. (JSR)

**12045** (CONF-7404111-, pp 229-268) SOIL CHEMISTRY. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Results are reported for the following studies: chemical equilibria and J/I relationship of zinc in acid soils, applicability of isotopic dilution methods for determination of the zinc supplying capacity of some Indian soils; quantity-intensity P relationships of some soils from northwest India; and surface activity of inorganic phosphorus fractions in some rice soils. (HLW)

**12046** (CONF-7404111-, pp 269-302) SOIL MOISTURE, IRRIGATION, AND WATER USE EFFICIENCY. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Results are reported for the following studies: the use of radiation techniques and other physical methods in field water balance and water use efficiency studies; tritium tracer technique for study of water movement in alluvial soils; and estimation of biomass and transpiration in some Indian trees using tritium. (HLW)

**12047** (HASL-298, pp I.107-I.128) ANALYSES OF QUALITY CONTROL SAMPLES AT HASL AND A CONTRACTOR LABORATORY DURING 1975. Hardy, E. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1-December 1, 1975. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.).

Sets of biological and fallout samples analyzed at HASL and by a contractor laboratory include quality control samples which are submitted as blinds. These checks consist of blanks, reference samples analyzed repeatedly over a period of years, replicates or splits of unknowns, spikes, and duplicate samplings. This report summarizes quality control data for ashed bone, various foods, tap water, and fallout samples analyzed for $^{90}Sr$, $^{137}Cs$, and Ca during 1975. (auth)

**12048** (INIS-mf-1802) ISOTOPE GEOCHRONOLOGY IN THE HIGH-GRADE METAMORPHIC PRECAMBRIAN OF SOUTHWESTERN NORWAY. Versteeve, A. J. (Rijksuniversiteit Utrecht (Netherlands)). 1974. 93p. INIS.

Isotope geochronological methods were applied to a high-grade metamorphic terrain in southwestern Norway, in order to arrive at a geochronological framework for the Precambrian evolution of this area. A great number of rocks were investigated including Rb-Sr whole-rock measurements, Rb-Sr and/or K-Ar analyses of separated minerals and U-Pb determinations on Zircon fractions from one sample of charnockitic rock. Also, a Rb-Sr whole-rock isochron analysis was made of the youngest phase of the plutonic complex. Most ages determined lie between 850 and 1200 Ma. (INIS)

**12049** (INIS-mf-1833) REPORT ABOUT THE TRITIUM AND CARBON-14 LABORATORIES OF THE INSTITUTE OF RADIOACTIVE RESEARCHES (BELO HORIZONTE, BRAZIL). Campos, M. M.; Chausson, Y. (Instituto de Pesquisas Radioativas, Belo Horizonte (Brazil)). 1973. 11p. (In Portuguese). INIS.

The basic aspects of the installations at IPR (Institute for Radioactive Researches) for the analysis of tritium and carbon-14 are described, furnishing at the same time information which could orient other institutions interested in such analyses. (INIS)

**12050** PROCESS AND DEVICE FOR CHECKING THE RELIABILITY OF NEUTRON WELL LOGGING DATA. Johnstone, C. W. (to Societe de Prospection Electrique Schlumberger). French Patent 2,228,226/A/. 29 Apr 1974. Priority date 1 May 1973, United States of America (USA). 28p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention concerns a device to verify the reliability of data obtained by neutron well-logging. The neutron population is detected at a position close to the neutron source and at a more distant position and the readings obtained are combined to determine if the values received are valid to represent the intrinsic value of characteristics being used to determine the composition of the formation studied. The invention is primarily usable for the study of petroleum-bearing terrains. (tr-FR)

**12051** PREDICTIONS OF ECONOMIC EFFICIENCY OF COMPLEX NUCLEAR GEOPHYSICAL METHODS IN EVALUATION OF INTERVALS WITH MERCURY MINERALIZATION IN AZERBAJDZHAN FIELDS. Aleskerova, F. D.; Kasumova, A. R.; Putkaradze, L. A. pp 194-197 of Geophysical Exploration in Azerbajdzhan. Proceedings of VNIIGeofiziki. Baku; Azerbajdzhanskoe Otdelenie VNIIGeofiziki (1973). (In Russian)

The economic effect of the introduction of complexes based on pulsed neutron logging increases as a result of the transfer of part

of the well into coreless drillings, reduction in assaying costs, and recovery of information lost as a result of incomplete core removal. Its value can be ~0.3 of the total drilling cost. (tr-auth)

**12052** SET OF "MOK"-PROGRAMS FOR NUCLEAR GEOPHYSICAL CALCULATIONS BY MONTE-CARLO METHOD. Enikeeva, F. Kh.; Lukhminskij, B. E. pp 225-227 of Monte-Carlo Methods in Computer Mathematics and Mathematical Physics. Novosibirsk; AN SSSR, Sibirskoe otdelenie (1974). (In Russian).

2 refs.

For the calculation of various problems of nuclear geophysics, a complex MOK program (Monte Carlo) was developed and widely tested. It is written in FORTRAN and unifies the organizational principles based on concepts of the spatial correlation of neutron trajectories in different media. The geological media principally considered in the program are the aluminosilicates of the following composition: $\bar{m}_1Al_2O_3 + \bar{m}_2Fe_2O_3 + \bar{m}_3SiO_2 + \bar{m}_4H_2O$, with $\Sigma_i\bar{m}_i = 1$. It was assumed that the neutron macroscopic cross section in these media changes sharply with change of the neutron energy (U, I eV $\leq E_n \leq$ 15 MeV) and with the composition of the media. (tr-INIS)

**12053** SUBSTANTIATION OF A POTENTIAL DETERMINATION OF INTERVALS WITH MERCURY MINERALIZATION IN WELLS BY PULSE NEUTRON LOGGING. Putkaradze, L. A.; Khilov, L. N.; Dolgin, M. G. pp 189-193 of Geophysical Exploration in Azerbadzhan. Proceedings of VNIIGeofiziki. Baku; Azerbajdzhanskoe otdelenie VNIIGeofiziki (1973). (In Russian).

2 refs.; 1 fig.; 1 table.

The use of pulsed neutron logging was recommended for the determination of the extent of mercury mineralization in well cross sections. The decrement of the thermal neutron density $\lambda$, close to the value $1/\tau$, is measured directly. $\tau$ is the lifetime of the thermal neutrons. Studies made on the Hg mineralization of Azerbaidzhan proved the validity of the method. The preliminary sensitivity threshold of the method was evaluated as 0.04 to 0.5%. Possibilities for an improvement of the reliability of the method and a decrease of the sensitivity threshold are bound with the use of $\gamma$ radiation from the radiative capture of thermal neutrons. (tr-auth)

**12054** RADIOACTIVE METHODS OF GEOCHRONOLOGY. Frost, R. (Karlova Universita, Prague (Czechoslovakia). Prirodovedecka Fakulta). Vesmir; 52: No. 6, 166-169(1973). (In Czech).

Various geochronological methods are described used in the absolute dating of earth crust minerals. (INIS)

**12055** CONTRIBUTION TO THE THREE-STAGE MODEL OF U–Pb ISOTOPIC SYSTEM. Chu, P. C. (Kweiyang Inst. of Geochemistry, Peking). Ti Ch'iu Hua Hsueh; No. 2, 123-134 (Jun 1975). (In Chinese)

By means of multi-dimensional regression analysis the author proposes for the first time the concept of "isochron plane" and develops two methods for solving three-stage U-Pb equations. Evolution of Nanling granites, metamorphic rocks from the Liaotung Peninsula and lunar basalts from Ocean Procellarum has been discussed in the light of U-Pb three-stage model calculations. The U-Pb third-stage model ages for these rocks are consistent with their K-Ar or Rb-Sr ages as well as with geological field observations. (JPRS)

**12056** APPLICATION OF GROUNDWATER MEASUREMENTS BY MEANS OF RADIOISOTOPES ON GROUNDWATER EXPLORATION. Drost, W. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Munich). pp 357-369 of Water for the Human Environment. Vol. I. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P1.

To measure the filtration velocity and the flow direction of groundwater, single-borehole methods using radioactive isotopes have been developed. Together with multiple-borehole methods they have been applied in the Federal Republic of Germany during the last decade in the solution of groundwater exploitation and waste disposal problems. The results provided valuable insights into potential groundwater yield, the origin of the groundwater, the vertical velocity profile within the aquifer, groundwater pollution risks, and the establishment of protection zones for groundwater production installations. This technique is valuable for predicting flow of radioactive and thermal effluents from nuclear power plants. (auth)

## Site Surveys

*Refer also to abstract 12005.*

**12057** (PAEC(D)-7328) SEA WATER MEASUREMENTS AT BAGAC, BATAAN AND SAN JUAN, BATANGAS FOR THE NUCLEAR POWER PROJECT. Interim Report, May 1972–June 1973. Corpus, G.; Aquino, R. C.; Singson, F. N. (Philippine Atomic Energy Commission, Manila). 1 Aug 1973. 26p. INIS.

Consideration of the general criteria on siting brought down the choice in the location of the country's first nuclear power plant site to two places—Bagac, Bataan and San Juna, Batangas. As a follow-up investigation activity under oceanography, this project concerns the measurement of sea water temperature and its variation with depth and time, and water contents. These parameters are needed in the economic evaluation of the sites as they relate to the design of intake structures and condenser system. Results of the weekly measurements of temperatures indicate cyclic tendency where temperature was highest in the months of May and June and lowest in January–February. The maximum variations were 4.7°C and 5.0°C around the annual average of 27.7°C and 28.2°C for Bagac and San Juan, respectively. Surface temperatures were consistently higher than depth temperatures—average of 0.3°C for Bagac and 0.4°C for San Juan. Both sites yielded high salinity water with about 37,000 parts per million solid contents for Bagac and 39,000 parts per million for San Juan. (INIS)

**12058** (USGS-474-223) RECONNAISSANCE GRAVITY SURVEY OF CENTRAL NEVADA. Healey, D. L. (Geological Survey, Denver, Colo. (USA)). 1967. Contract AT(29-2)-474. 11p. Dep. NTIS $4.50.

Submitted in the report is a reconnaissance gravity map (scale 1:250,000) based on 1,475 stations for an area of 8,500 square miles (22,015 $km^2$) in central Nevada. Included is a table showing average rock densities obtained from gamma-gamma logs run in 11 drill holes. The interpretation of gravity data is highly dependent upon the bulk density of the buried rocks and alluvium and upon the assumption of the regional gradient. The reconnaissance gravity data are being interpreted using in situ bulk density data obtained from continuous gamma-gamma density logs. The average density for 9,433 feet (2,875 m) of Quaternary alluvium is 2.03 $g/cm^3$ (excluding data from Hot Creek Valley). The average density for 9,424 feet (2,872 m) of Tertiary volcanic rock is 2.34 $g/cm^3$. A tentative regional gradient, based on the average elevation within a 39.8-mile (64-km) radius of each of 34 stations located on Paleozoic sedimentary rock, was computed by the method of least squares. (auth)

## Thermal Effluents

*Refer also to abstracts 12056 and 12074.*

**12059** EFFECTS OF SALINITY AND CYCLIC TEMPERATURE ON SURVIVAL OF TWO SYMPATRIC SPECIES OF GRASS SHRIMP (PALAEMONETES), AND THEIR RELATIONSHIP TO NATURAL DISTRIBUTIONS. Thorp, J. H. (North Carolina State Univ., Raleigh); Hoss, D. E. J. Exp. Mar. Biol. Ecol.; 18: No. 1, 19-28(May 1975).

Survival of the grass shrimp Palaemonetes pugio and P. vulgaris from the Newport River estuary after continuous exposure to cyclic temperature regimes of 7 to 13 centigrade degrees at 20 to 35 ppt salinity was similar to that observed for comparable constant temperatures; however, at 5 ppt, mortality was significantly lower under the cyclic regime than under either of the constant regimes of 7 and 10 C. A rapid, transient decrease from either 7 or 10 C to 2 C had no measurable effect on survival or rate of oxygen consumption at any of nine temperature-salinity acclimations. Habitat partitioning appeared to be unaffected by salinity (except in areas intermittently subjected to 3 ppt) and winter temperatures.

**12060** COMPARISON OF THERMAL LOADING EFFECTS ON BACTERIAL POPULATIONS IN POLLUTED AND NON-POLLUTED AQUATIC SYSTEMS. Guthrie, R. K. (Clemson Univ., SC); Cherry, D. S.; Ferebee, R. N. Water Res.; 8: No. 3, 143-148(Mar 1974).

Water from 2 aquatic systems (a new, nonpolluted lake and a lake receiving municipal and industrial wastes) was studied for alterations in bacterial populations following temperature increases of 5°C-10°C. Lake water was studied under laboratory conditions utilizing 50-l tank batteries to permit controlled temperature maintenance. Plate count agar was used for counts of total culturable heterotroph and chromagenic colonies. Selected limiting nutritional media were used to determine these types. Increases in total counts were observed in all systems during initial periods at temperatures 3°C-5°C above ambient; however, at 5°C-10°C above ambient, total counts and the number of different genera isolated were reduced. Effects on nutritional types and percentage of chromagenic types present were analyzed. Thermal addition is a potential method to restore natural

bacterial populations to sewage-polluted aquatic environments. (Pollut. Abstr.)

**12061** EXPERIMENTAL SIMULATION OF STOCHASTIC STREAM RESPONSE TO THERMAL INPUTS AND APPLICATION OF SPECTRAL ANALYSIS TECHNIQUES. Krishnan, K.P.R. (Kansas State Univ., Manhattan). Water Res.; 8: No. 7, 455-466(Jul 1974).

Experimental data on stream temperature were collected using a laboratory model by superimposing cyclic and continuous noncyclic thermal discharges (stream was used as the thermal discharge) on the inherently noisy signals of the stream. The resulting data measured at 2 different points along the stream were processed by spectral analysis. Flow rate and position of measurement played important roles in drawing information from the data. The cyclic nature of the periodic thermal discharge could be observable in the autocorrelation and power spectrum. (Pollut. Abstr.)

**12062** THERMAL TOLERANCE AND BIOCHEMICAL POLYMORPHISM OF IMMATURE LARGEMOUTH BASS MICROPTERUS SALMOIDES LACEPEDE. Smith, M. H. (Savannah River Ecology Lab., Aiken, SC); Scott, S. L. Bull. Ga. Acad. Sci.; 33: No. 4, 180-184(Sep 1975).

Immature largemouth bass were collected by seining from Par Pond Reservoir, taken to the laboratory, and slowly acclimated at temperatures of 20, 28, and 36$^0$C. At 36$^0$C none of the fish survived the one week acclimation period. Mortality rates of fish acclimating at lower temperatures were significantly less. The critical thermal maximum of each bass was determined by observing the point at which the fish lost its sense of orientation and equilibrium. Allele frequencies were essentially the same among fish surviving the acclimation process as in the parental population. (HLW)

**12063** TEMPERATURE INFLUENCE ON CHEMICAL TOXICITY TO AQUATIC ORGANISMS. Cairns, J. Jr.; Heath, A. G.; Parker, B. C. (Virginia Polytechnic Inst. and State Univ., Blacksburg). J. Water Pollut. Control Fed.; 47: No. 2, 267-280(Feb 1975).

The literature on the effects of temperature on chemical toxicity to aquatic animals and microorganisms is reviewed. Microbial photosynthesis and respiration is briefly discussed. It is concluded that there is a paucity of information on the inter-relations of temperature and toxicants to algae, bacteria, and protozoa and that standards based on the in situ response of indigenous organisms to specific discharge areas should be developed.

**12064** POLLUTION ENGINEERING TECHNIQUES: AN OVERVIEW INTRODUCTION TO THE PROBLEM, PHILADELPHIA, PENNSYLVANIA, OCTOBER 22–25, 1973. Ann Arbor, MI; Ann Arbor Science Publishers, Incorporated (1974). 216p. (CONF-7310118-). Ann Arbor Science Publishers, Inc., MI.

From 2nd annual international pollution engineering congress; Philadelphia, Pennsylvania, USA (22 Oct 1973).

The 34 papers presented at the Conference are compiled. Together they offer an overview and introduction to the many varied aspects of pollution engineering, including federal guidelines, methods of compliance, waste processing and disposal, control of noise and odor, and conservation. An abstract was prepared for one paper that was prepared under ERDA sponsorship. (JSR)

**12065** SOLVING THE PROBLEMS OF THERMAL EFFECTS AND OUTPUTS. Jaske, R. T. pp 102-114 of Pollution Engineering Techniques: An Overview Introduction to the Problem. Ann Arbor, MI; Ann Arbor Science Publishers, Inc. (1974).

From 2nd annual international pollution engineering congress; Philadelphia, Pennsylvania, USA (22 Oct 1973).

All energy used ultimately appears in the environment as a thermal release, this paper points out, and many of the measures taken to reduce other types of pollutants ultimately increase thermal pollution because energy is required to operate the pollution control equipment. A number of measures that may be taken to reduce the ratio of net energy use to gross national product are pointed out. (auth)

**12066** WATER FOR THE HUMAN ENVIRONMENT. Volume I. Congress Papers. Proceedings of the First World Congress on Water Resources Held in Chicago, Illinois, September 24–28, 1973. Chow, V. T.; Csallany, S. C.; Krizek, R. J.; Preul, H. C. (eds.). Champaign, IL; International Water Resources Association (1973). 491p. (CONF-7309143–P1).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973).

Forty-three papers were presented. Two papers on thermal pollution were separately abstracted for NSA. (PCS)

*For abstracts of individual papers see: 12056 and 12067.*

**12067** WARMING OF THE WORLD'S WATERS BY MAN. Brady, D. K. (Johns Hopkins Univ., Baltimore). pp 48-57 of Water for the Human Environment. Vol. I. Chow, V. T. (ed.). Champaign, IL; International Water Resources Association (1973).

From 1st world congress on water resources; Chicago, Illinois, USA (24 Sep 1973). See CONF-7309143-P1.

Man's average thermal influence on earth is exceedingly small, therefore his waste heat should be spread over the earth's surface as uniformly as possible. The trend towards mammoth power plants tends to concentrate rather than disperse waste heat. Dilution of thermal discharges is sometimes contrary to accepted principles of efficient heat dissipation. Ecological damage due to biological entrainment in cooling water systems may be reduced by shifting condenser design to either high-flow or high-temperature alternatives. (auth)

**12068** ENVIRONMENTAL IMPACT OF A SUITABLE NUCLEAR POWER REACTOR USED TO PROVIDE A PROCESS HEAT SYSTEM TO SYNTHESIZE FUELS. Richardson, J. A. (Burns and Roe, Inc., Oradell, NJ). pp 1137-1156 of Hydrogen Energy. Part B. Veziroglu, T. N. (ed.). New York; Plenum Publishing Corp. (1975).

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974). See CONF-740306-PB.

The environmental impact of an 1100-MWE light water nuclear power reactor used to provide a process heat system to synthesize fuels is evaluated covering thermal pollution, visual pollution, and radioactive water quantities produced and released to the environment. (auth)

## Chemical Effluents

*Refer also to abstracts 11541, 11943, 12020, 12031, 12041, and 14074.*

**12069** (AERE-R-7729) ATMOSPHERIC CONCENTRATIONS AND DEPOSITION RATES OF SOME TRACE ELEMENTS MEASURED IN THE SWANSEA/NEATH/PORT TALBOT AREA. Pattenden, N. J. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Mar 1974. 117p. Dep NTIS (US Sales Only) $6.50. UK£2.00.

As part of a larger survey of metallic pollution of the atmosphere in the Swansea/Neath/Port Talbot area, samples of air particulate, dry deposited dust and rain have been collected between June 1972 and May 1973 at 9 different locations in the area. They have been analyzed for V, Cr, Co, Ni, Cu, Zn, As, Se, Cd, Hg, Pb, and other trace elements largely by the methods of instrumental neutron activation, x-ray fluorescence and atomic absorption. The highest annual average concentrations of these elements which were observed in the air particulate sampling throughout the region were as follows (in ng element/m$^3$ air): V-26, Cr-17.4, Co-48 Ni-160, Cu-70, Zn-920, As-17.5, Se-6.3, Pb-680. The Cd and Hg values were usually below the detection limits of about 100 and 0.5 respectively. The results show that the atmospheric concentrations at the sampling stations are negligible compared to published threshold limit value concentrations. There is strong evidence for local pollution sources of Co and Ni in the Swansea Valley near Clydach, with the suggestion that the Co comes from wind-blown industrial waste tips. There is evidence for local pollution sources of Zn and Pb in the Baglan area. The presence of nickel in particulate form in the Swansea Valley atmosphere at relatively high concentration suggests the need for atmospheric surveillance for volatile nickel carbonyl. An interpretation of the results is given, which utilizes correlations between the variations with time of the concentrations of pairs of elements, the variations of concentration with wind direction at each station, and a study of the particle size associated with certain elements at one. The latter study, which was carried out with a multi-stage cascade impactor sampler, demonstrates a correlation between the particle mass median diameter and the velocity of dry deposition. (auth)

**12070** (HASL-298) HEALTH AND SAFETY LABORATORY ENVIRONMENTAL QUARTERLY, SEPTEMBER 1–DECEMBER 1, 1975. Hardy, E. P. Jr. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). 1 Jan 1976. 201p. Dep. NTIS $8.50.

Separate abstracts were prepared for eight sections of this report. (CH)

*For abstracts of individual sections see: 12018–12023, 12047, and 12071.*

**12071** (HASL-298, pp I.83-I.106) HALOCARBONS IN THE STRATOSPHERE. Krey, P. W.; Lagomarsino, R.; Schonberg, M.; Frey, J. J. 1 Jan 1976.

In Health and Safety Laboratory environmental quarterly, September 1–December 1, 1975. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.).

In April 1975 the stratospheric inventories of $CCl_3F$, $CCl_4$ and $SF_6$ were 260, 240 and 0.95 gigagrams, respectively. Based on the HASL box model of atmospheric transport, the three stratospheric inventories of $CCl_3F$ measured since April 1974 are compatible with a stratospheric photolysis half life of 2 to 3 years and a total atmospheric half life of 18 to 24 years. Ratios of $CCl_3F$ to $^{85}Kr$ and HT in October 1974 decrease with altitude suggesting an increasing rate of photolysis of $CCl_3F$ with height. Stratospheric stability increases from $CCl_4$ less than $CCl_3F$ less than $SF_6$. Ratios of the three gases suggest a stratospheric circulation pattern similar to that observed for several radioactive substances released in the stratosphere. HCl from the destruction of $CCl_3F$ accounts for about 30 percent of the measured HCl in the stratosphere. (auth)

**12072** (HASL-298(App.)) APPENDIX TO HEALTH AND SAFETY LABORATORY ENVIRONMENTAL QUARTERLY, SEPTEMBER 1–DECEMBER 1, 1975. (Energy Research and Development Administration, New York (USA). Health and Safety Lab.). 1 Jan 1976. 495p. Dep. NTIS $11.00.

Data are tabulated on the deposition of fallout $^{90}Sr$ at world land sites during 1975, radionuclides and Pb in surface air, and the content of $^{90}Sr$ in milk and drinking water samples from various locations. (CH)

**12073** (TID-26608) HANDBOOK ON AEROSOLS. Dennis, R. (ed.). (GCA Corp., Bedford, Mass. (USA). GCA Technology Div.). 1976. 148p. Dep. NTIS $6.00.

The subject of aerosols is discussed extensively under the following chapter headings: objectives, organization, and applications; aerosol generation; dynamic behavior of aerosols; optical properties of aerosols; sampling and particle-size measurement; and summary tables and graphs for static and dynamic characteristics of aerosol systems. A glossary, nomenclature, and index are included. (ERB)

**12074** (UCID-16927) RESPONSE TO SUBCOMMITTEE ON ENVIRONMENT AND ATMOSPHERE. MacCracken, M. C. (California Univ., Livermore (USA). Lawrence Livermore Lab.). Oct 1975. Contract W-7405-Eng-48. 11p. Dep. NTIS $4.50.

The potential effects of chronic release of pollutants on climatic changes are discussed with regard to dose-response characteristics, ambiguities in prediction of climatic effects, ambiguities in measuring climatic effects, research approaches, and approaches to standard setting. A table is presented to show potential atmospheric effects of the following pollutants: $CO_2$ from fossil fuels, fluorocarbons, nitrogen oxides, $^{85}K$ from nuclear power plants, sulfur compounds, dusts, heat and water releases from energy generation processes, and oceanic oil slicks. (HLW)

**12075** (Y-DD-186) CHROMATE ABATEMENT AT THE OAK RIDGE Y-12 PLANT. Sanders, M. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1975. Contract W-7405-eng-26. 23p. (CONF-750967-9). Dep. NTIS $4.25.

From 3rd ERDA environmental protection conference; Chicago, Illinois, USA (23 Sep 1975).

A fifteen month field study was completed that utilized four non-chromate based water treatment programs in the sixteen low temperature towers using corrosion and deposition studies, microbiological control, and plant effluent creek analyses as evaluation parameters. The study succeeded in reducing the levels of chromate in the plant effluent well below the limits established by the Environmental Protection Agency. (auth)

**12076** UPTAKE AND MIGRATION OF TRACERS IN LAKE SEDIMENTS. Lerman, A.; Lietzke, T. A. (Northwestern Univ., Evanston, IL). Limnol. Oceanogr.; 20: No. 4, 497-510 (Jul 1975).

Mathematical solutions are given for an equation describing transient and steady state concentrations in lake water and sediments, in the presence of adsorption, decay, sedimentation, and diffusion. The results of the model are compared with the distributions of two tracers, $^{90}Sr$ and $^{137}Cs$, in the sediments of Lakes Erie and Ontario. Adsorption of the two tracers by sediment particles, supported by experimental data, can be treated as a linear exchange reaction. $^{90}Sr$ is adsorbed less strongly than $^{137}Cs$ by sediments, and this feature accounts for the greater depths of $^{90}Sr$ occurrence in lake sediments. Distribution of the radionuclide activities in sediments is compatible with a model based on mean steady input to the lakes for 16 years (1953 to 1969), and the following values of diffusion coefficients in pore waters: for $^{90}Sr$, $2 \times 10^{-6}$ to $4 \times 10^{-6}$ $cm^2\ s^{-1}$, and for $^{137}Cs$, $2 \times 10^{5}$ $cm^2\ s^{-1}$. An additional transport mechanism in sediments, sedimentation, is more significant in Lake Erie (0.3 to 0.6 cm $yr^{-1}$, according to the model) than in Lake Ontario (0.05 cm $yr^{-1}$). Conditions are outlined under which the fluxes from lake water to sediments are important in the chemical balance of medium and large lakes. (auth)

# INSTRUMENTATION

## Radiation Detection Instruments

### *General Detectors and Monitors*

*Refer also to abstracts 11463, 12018, 12039, 12368, 12709, 12947, 12994, 13665, and 13803.*

**12077** (AIAU-74202) THE ABSOLUTE MEASUREMENT OF THE THERMAL NEUTRON FLUX DENSITY. Bensch, F. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Dec 1974. 96p. (In German). INIS.

Full size copies also available from the author.

The absolute measurement of the thermal neutron flux density is discussed with reference to the corrections required. In particular, the problems of flux depression are analysed. The thermal neutron flux depression in a diffusing medium by an absorbing foil has been treated in numerous papers. The results are re-examined in an attempt to find a uniform and physically meaningful representation of the "activation correction". This quantity can be split up into a combination of probabilities. Thus, it is possible to determine the activation correction for any moderator and foil material. Measurements confirm the utility of the concepts introduced. (auth)

**12078** (BARC/I-269) AN AUTOMATIC SAMPLE CHANGER FOR ALPHA LIQUID SCINTILLATION COUNTING. Samuel, J. K.; Satsangi, M. S. (Bhabha Atomic Research Centre, Bombay (India)). 1973. 11p. INIS.

1 table, 12 figures.

Details of an automatic sample changer system for an alpha liquid scintillation set-up for assaying of alpha-sources are described. The system consists of the following units: (1) sample changer in which 12 scintillation vials can be loaded at a time, (2) sample changer control unit, (3) detection assembly, (4) prirting timer, (5) high voltage unit, (6) decade scaler, (7) linear amplifier, (8) pulse height discrimination, and (9) power supply unit. These units are described and their assembly into the system and functioning of the system are explained. (INIS)

**12079** (BNWL-MA-62(Pt.2)) PORTABLE RADIATION SURVEY INSTRUMENT MANUAL. Fleming, D. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 21 Aug 1973. 104p. Dep. NTIS $5.50.

The External Dose Evaluation Manual, BNWL-MA-6Z, is being issued by sections as individual procedures are completed to describe the portable radiation survey instruments in use on the Hanford site. The manual is in two parts. Part 1 covers general administrative and technical procedures associated with instrument procurement, radiological standards functions, criticality and high level exposure analysis, and special dosimetry capabilities. The specifications, calibration, operation, performance, and uses of the CP and extended CP (XCP) ionization chambers; the Juno dose ratemeter; the portable count rate meters EGM and PAM; the SNOOPY neutron dose rate meter; the Cutie Pie–Totem Pole meters LPC, TPC, and HPC; the Radeco Portable Alpha Monitor (PAM), and the Low Level Monitor (LLM) are presented. (WHK)

**12080** (CEA-N-1791, pp 66-67) PROGRAM FOR STUDYING ANGULAR CORRELATIONS (SELECTION CODE). Lepareux, M. [nd]. (In French).

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A program has been written to analyse off-line on the 10020 computer the coincidence measurements between two position sensitive detectors using 5 parameters. (FR)

**12081** (CEA-N-1791, pp 192-194) STUDY OF THE TRANSITION RADIATION. Bolore, M.; Filippi, G.; Lasalle, J.; Roland, S.; Wartski. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

New applications of the transition radiation have been found: monitoring of low peak currents; measurement of short burst lengths; optimization of the klystron phases. (FR)

**12082** (CEA-N-1791, pp 198-199) STUDY OF THE FISSION CROSS SECTION FOR $^{239}$Pu IN THE RESONANCE REGION. Derrien, H.; Lucas, B. [nd]. (In French).

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The $^{239}$Pu fission cross section was measured with the proton recoil detector in order to test the possibilities of this detector. It is shown that the resolution and the background sensitivity are particularly good. (FR)

**12083** (CEA-R-4704) POSITION ENCODER. Goursky, V. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Services d'Electronique). Nov 1975. 34p. (In French). Dep. NTIS (US Sales Only) $4.25.

This paper describes circuitry for deriving the quotient of signals delivered by position-sensitive detectors. Digital output is obtained in the form of 10 to 12 bit words. Impact position may be determined with 0.25 percent accuracy when the dynamic range of the energy signal is less than $^1/_{10}$, and 0.5 percent accuracy when the dynamic range is $^1/_{20}$. The division requires an average time of 5 mu s for 10-bit words. (auth)

**12084** (CONF-741040-P1, pp 365-370) NEUTRON STANDARDS AT THE NATIONAL BUREAU OF STANDARDS. Meier, M. M. (National Bureau of Standards, Washington, DC). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

The neutron standards program at NBS is discussed with emphasis on Van de Graaff contributions to the overall program. In particular, the characteristics of an associated particle apparatus, which serves as a primary standard for flux normalization at the three percent accuracy level are presented. The "black" detector, a secondary standard suitable as a flux monitor for linac applications and for dosimetry, is characterized, and its calibration with the associated particle technique is described. Future goals of the program are outlined, and the role of the Van de Graaff/associated particle system in achieving these goals is discussed. (auth)

**12085** (CRN/PN-74-9) CHARACTERIZATION BY MEASUREMENT OF THE LIFETIMES OF SEMICONDUCTOR MATERIALS WITH CONSIDERATION OF THEIR USE IN NUCLEAR SPECTROMETRY. Berger, R. (Centre National de la Recherche Scientifique, 67- Strasbourg (France). Centre de Recherches Nucleaires). 1974. 98p. (In French). Dep. NTIS (US Sales Only) $6.00.

Thesis. Submitted to Strasbourg Univ., France.

Perturbations in semiconductors are studied by the measurement of the lifetimes of excess carriers. A brief synthesis is given of the numerous definitions of lifetime found in the literature and the definition of this concept used in the present study is presented. The experimental measurement conditions are reported in detail. The variation of the lifetime of carriers with the temperature is studied as a means of investigation of the deep levels in the forbidden band of semiconductors. This method is shown to be completely ineffective in the presence of complex spectra for CdTe, Ge, and Si of standard quality. Only results obtained with ultrapure Ge allow a satisfactory interpretation. The observation of the decline of the photoconductivity is found to be a satisfactory method. A correlation is obtained between the lifetimes measured by Henck and Stuck on Li-compensated detectors and those obtained in the present study on the corresponding monocrystals. The correlation makes it possible to select a priori samples containing the lowest concentration of dislocations. A procedure for improving the crystals used is deduced. (JSR)

**12086** (JAERI-M-5988) TEMPERATURE CYCLING TEST OF A HYPER-PURE GERMANIUM DETECTOR. Sakai, E.; Terada, H.; Katagiri, M.; Itoh, H. (Japan Atomic Energy Research Inst., Tokyo). Feb 1975. 38p. (In Japanese). INIS.

Temperature cycling test of a hyper-pure germanium detector (Nuclear Radiation Developments, PHYGE charged-particle detector, Model No. 05005B, Serial No. 100P5P3, 50 mm$^2$ × 5 mmt) was performed under cryostat vacuum. The total duration of the detector at room temperature was 340 hr (seven temperature cycles between 77 K and room temperature). The leakage current, capacitance, gamma-ray peak detection efficiency, and energy resolution showed very little change. The detector was found to be very stable against temperature cycling. (auth)

**12087** (JINR-3-7887) SMALL-SIZED NEUTRON DETECTOR IN BATTERY FORM CONSISTING OF $^3$He PROPORTIONAL COUNTERS. Bemer, B.; Van'kov, A. A.; Grigor'ev, Yu. V.; Dittse, K.; Kepernik, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1974. 15p. (In Russian). INIS.

15 refs.; 7 figs.

Physical characteristics, construction features, and electronic diagrams of a neutron detector in the form of a battery of 91

proportional $^3$He counters (SNM-50 type) are described. The detector has time and spectrometric characteristics good enough for carrying out a wide range of neutron measurements by the time-of-flight method. Dead time is 1 $\mu$ sec, energy resolution for the thermal neutron peak is about 11%, efficiency of thermal neutron recording is about 100%, and at about 1 keV energy is about 5%. The detector has a background of no more than 0.4 counts per second and is practically insensitive to gamma radiation. (tr-auth)

**12088** (LA-6121-MS) SHIFT REGISTER NEUTRON COINCIDENCE MODULE. Stephens, M. M.; Swansen, J. E.; East, L. V. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 8p. Dep. NTIS $4.50.

A neutron coincidence module was designed using multistage shift registers to produce the coincidence gates and a crystal controlled oscillator with variable clock outputs to change the gate lengths. The advantage of this system over the conventional, thermal-neutron coincidence gates is a decrease in deadtime by more than an order of magnitude. (auth)

**12089** (LA-UR-75-2084) TWO-DIMENSIONAL NONREDUNDANT ARRAYS FOR CODED APERTURE IMAGING. Han, K. S.; Berzins, G. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 11p. (CONF-751141-1). Dep. NTIS $4.50.

From meeting on fuel and clad motion diagnostics in LMFBR safety test facilities; Albuquerque, New Mexico, USA (11 Nov 1975).

The use of nonredundant pinhole arrays (NRPA) for imaging of radiation sources is discussed. The processes involved in recording and reconstructing coded aperture images are described. (DG)

**12090** (LUIP-CR-75-04) MEASURED AND CALCULATED ABSORPTANCE OF TRACKS OF FAST HEAVY IONS IN ILFORD G5 NUCLEAR EMULSION. Jensen, M.; Mathiesen, O. (Lund Univ. (Sweden). Fysiska Institutionen). Apr 1975. 32p. Dep. NTIS (US Sales Only) $4.00.

A modified form of the $\delta$-ray theory of track formation developed by Katz and coworkers has been used to calculate the absorptance of tracks of fast heavy ions in Ilford G5 nuclear emulsion. The theoretical data have been compared with results of different photometrical investigations reported in the literature. In most cases the theoretical predictions are found to be in good agreement with experiments. This suggests that the theory can be used in the planning and execution of future experiments, i.e., to optimize the geometry of the photometer and to obtain an absolute charge calibration of the detector. It is shown that the basic photometrical properties of an emulsion stack can be described by a single quantity which can be determined from measurements. Knowing this quantity it is possible to predict the response of the emulsion stack for different types of photometers. The practical limits of the use of the modified theory at high and low levels of energy dose are discussed. (auth)

**12091** (Y-2004) SYSTEM FOR MEASURING THE URANIUM CONCENTRATION OF LIQUID EFFLUENTS FROM THE ENRICHED URANIUM RECOVERY FACILITY AT THE OAK RIDGE Y-12 PLANT. Gallman, R. A. (Oak Ridge Y-12 Plant, Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 20p Dep. NTIS $4.00.

A real-time, on-line monitor has been developed which can measure the uranium concentration of enriched uranium liquid effluent. The monitor uses the thorium L x-ray activity from the decay of $^{234}$U as the basis for the measurement. A sodium iodide/thallium-activated scintillation crystal, optically coupled to a photomultiplier, is used as the detector. Evaluation results reveal that the limit of error over the uranium concentration calibration range is less than 1 wt ppM, and the lower limit of sensitivity is 0.50 wt ppM. This monitor cannot be used on a recovery facility which contains fission products. The monitor is installed in the Oak Ridge Y-12 Plant enriched uranium recovery facility and has been operating satisfactorily for some time. (auth)

**12092** POSITION SENSITIVE MULTIWIRE PROPORTIONAL COUNTER WITH INTEGRAL DELAY LINE. Gilland, J. R.; Emming, J. G. (to Ball Brothers Research Corp.). US Patent 3,911,279. 7 Oct 1975. Filed date 17 May 1973. 8p.

A position sensitive multiwire proportional counter with integral delay line including a support carrying a plurality of anode wires and at least one cathode wire spaced in a predetermined relationship from the anode wires within the active volume of the counter to form an integral delay line is described. The counter is filled with a gas which ionizes upon interaction with ionizing radiation, the ionization of the gas being enhanced by the positive anode, such that an electrical charge is thereby induced in the cathode wire. Sensing of elapsed time between receipt of the induced charge at opposing ends of the cathode wire is utilized to determine the desired radiation positional data. (auth)

**12093** RADIATION SENSING DEVICE. Stout, K. J. (to Ohio Nuclear, Inc.). US Patent 3,911,278. 7 Oct 1975. Filed date 14 Jun 1973. 8p.

A radiation sensing device is described including a collimator, a disc-shaped scintillation crystal in close proximity thereto; at least three substantially parallel photomultiplier tubes adjacent to one side of the scintillator and circuitry for locating a scintillation in the crystal. In particular, the circuitry includes a diode bias to correct for distortion and non-uniformity which results from placing the photomultiplier tubes adjacent to the scintillator. (auth)

**12094** GAMMA CAMERA. Berninger, W. H. (to General Electric Co.). US Patent 3,919,556. 11 Nov 1975. Filed date 15 May 1974. 22p.

The light pulse output of a scintillator, on which incident collimated gamma rays impinge, is detected by an array of photoelectric tubes each having a convexly curved photocathode disposed in close proximity to the scintillator. Electronic circuitry connected to outputs of the phototubes develops the scintillation event position coordinate electrical signals with good linearity and with substantial independence of the spacing between the scintillator and photocathodes so that the phototubes can be positioned as close to the scintillator as is possible to obtain less distortion in the field of view and improved spatial resolution as compared to conventional planar photocathode gamma cameras. (auth)

**12095** SATURATION CURVE IN GASES OF HIGH ATOMIC NUMBER AT PRESSURES UP TO 8 ATM. I. Krypton and Xenon. Boag, J. W.; Barish, R. J.; Seelentag, W. W. (Inst. of Cancer Research, Belmont, Eng.). Med. Phys.; 2: No. 5, 245-250(1975).

The saturation curve has been studied in xenon and in krypton up to a pressure of 8 atm. An empirical formula has been found that describes the fraction of current collected over a wide range of voltages, pressures, ionization intensities, and electrode spacings. This is of practical value in the design of ionography chambers. For krypton the collection fraction f/sub Kr/ equals $(1 + 0.25\ eta^{-1.74})^{-1}$, and for xenon f/sub Xe/ equals $(1 + 0.16\ eta^{-1.88})^{-1}$, where eta equals $Fp^{-0.7}Vd^{-2}q^{-1}/_2$ with F equals $3.61 \times 10^{-7}$ and $2.50 \times 10^{-7}$ for krypton and xenon, respectively. The ranges of the variables covered in the experiments were p equals 1–8 atm, V equals 5–25000 V, d equals 0.3–1.3 cm, and q equals $4 \times 10^{-8}$–$6 \times 10^{-6}$ A/cm$^3$. (auth)

**12096** AVERAGE RESONANCE CAPTURE EXPERIMENTS WITH PULSED BEAMS. Bird, J. R. (Australian Atomic Energy Commission, Lucas Heights). pp 371-373 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd International symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920–.

Filtered neutron beams are suitable for measurements of gamma-ray spectra averaged over many resonances in a specific neutron energy interval. Two methods have been developed recently at Lucas Heights for studying averaged spectra as a function of neutron energy from 10 keV up to 1 MeV including the Ge(Li) broadening technique and the discrete energy method. Some of the features incorporated in these experiments are discussed. (WHK)

**12097** IN-SITU ANALYSIS OF MINERALS BY MEANS OF NEUTRON CAPTURE TECHNIQUES. Fanger, U.; Pepelnik, R. (Nuclear Research Center, Karlsruhe, Ger.). pp 743-748 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd International symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920–.

In the field of ore prospection and exploration, neutron capture gamma-ray spectroscopy using isotopic neutron sources and Ge(Li) detectors provides a potent tool for in-situ analysis. The physical prerequisites as well as some technical aspects of (n, $\gamma$) applications are discussed. Experimental results of studies with marine ore concretions and sediments are given as examples. (3 figures) (auth)

**12098** INFRARED SPECTROMETRY STUDY OF $\gamma$ AND HEAVY ION IRRADIATED CELLULOSE TRIACETATE. Moliton, J. P.; Barussaud, A.; Vareille, J. C.; Teyssier, J. L. (Limoges Univ., 87 (France). Lab. des Radiations Ionisantes). Rev. Phys. Appl.; 10: No. 3, 109-115(May 1975). (In French).

A study of cellulose triacetate as a solid state track detector shows infrared techniques that, in $\gamma$-irradiated cellulose triacetate films at 20°C, hydrogen bonds between neighboring cellulosic chains are mainly produced. $\gamma$ preirradiation creates a strong amplification of heavy ions effects. Therefore, primary and secondary reactions induced by heavy ions can be considered also as taking place between neighboring cellulosic chains. (FR)

12099 TRACK FORMATION THEORY BY KATZ AND COWORKERS APPLIED TO IONIZATION MEASUREMENTS IN NUCLEAR EMULSION. Jensen, M.; Mathiesen, O. (Lund Univ. (Sweden)). Radioprotection; 9: No. 4, 259-270(1974).

A comparison was made of the theoretical and experimental profiles of heavy ions track in nuclear emulsions. The experiments were conducted with ions (charge interval $14 \leq Z \leq 26$ and velocity interval $0.3 \leq \beta \leq 0.8$) whose track profiles were measured by means of two parameters with rectangular slits. The theoretical calculations used Katz's theory on energy distribution around the track and transmittance of direct and diffused light by Ag-Br grains. There was a very good agreement between theoretical and experimental data, and a single quantity could be used to characterize an emulsion stack response. An examination of the experimental data obtained by other investigators showed that the theory also applied to ions with $Z > 26$. (FR)

12100 FREQUENCY ANALYSIS AND SCINTIGRAPHY PROCESSING. III. Enhancement Linear Stationary Filters. Berche, C.; Di Paola, R. J. Biol. Med. Nucl.; 9: No. 38, 8-41 (1974). (In French).

The theory of frequency analysis and its use in the linear scintigraphy processing is presented. The main noise cleaning linear stationary filters and the linear stationary filters employed for enhancement of scintigraphic image are described. (FR)

12101 CRYSTALS WITH A SURFACE DEFORMED BY A NONEPITAXIAL GROWTH. (to Kewanee Oil Co.). French Patent 2,207,756/A/. 30 Nov 1972. 19p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

These crystals are obtained by contact with an agent generating finely divided solid crystals with particle dimensions between less than 44 and 175 $\mu$m for a predetermined length of time. The crystal generating agent is associated with a sufficient quantity of a transferable fraction capable of causing by growth a non-epitaxial layer on the surface of the base crystal. This growth takes place in a uniform, but nevertheless unordered manner, independent of the microscopic orientation of the base crystal. These crystals can be used for scintillators. (tr-FR)

12102 DEVELOPMENT OF NUCLEAR INSTRUMENT PRODUCTION IN CZECHOSLOVAKIA IN THE PAST 20 YEARS. Gilar, O. (Tesla, Premysleni (Czechoslovakia). Vyzkumny Ustav Pristroju Jaderne Techniky). Jad. Energ.; 20: No. 10, 336-341(Oct 1974). (In Czech).

A survey is given of the development of nuclear technology instruments in Czechoslovakia in the past 20 years. The production programme of INTERATOMINSTRUMENT, an organization associating certain CMEA countries, is described and the tasks resulting from it for Czechoslovakia are listed. (INIS)

12103 NEW TYPES OF LIQUID SCINTILLATORS. Spurny, F. (Ceskoslovenska Akademie Ved, Prague. Laborator Radiologicke Dozimetrie). Jad. Energ.; 20: No. 11, 372-374(Nov 1974). (In Czech).

Scintillation characteristics are described of new types of liquid scintillators that are being introduced in industrial production in Czechoslovakia. The properties of p-xylene-based scintillators and of a new activator, 2-(4'-t-butyl phenyl)-5-(4''-biphenyl)-1,3,4, oxadiazole (t-butyl-PBD) are given. (auth)

12104 MEASUREMENT OF THE TIME CHARACTERISTICS OF LARGE PLASTIC SCINTILLATORS. Bagdasaryan, L. S.; Kulikov, V. V.; Tashchyan, A. A.; Farmanyan, S. S. (Inst. of Physics, Erevan). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 404-405(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 67-68(1975).

The results of measuring the time characteristics of plastic scintillators having large dimensions (polystyrene; polyvinyltoluene, and methylmetacrylate) are presented. (auth)

12105 MULTIFILAMENT PROPORTIONAL CHAMBER FOR AN ALPHA SPECTROGRAPH. Biryukov, V. A.; Vakhtel, V. M.; Golovkov, N. A.; Zinov, V. G.; Konin, A. D.; Ormandzhiev, S. I. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 408-410(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 71-72(1975).

A multifilament proportional chamber with analog acquisition of information is described; the device is designed for automatic measurement of spectra in the large $\alpha$ spectrograph of the JINR. (auth)

12106 INSTRUMENTAL CORRECTION OF THE EFFECT OF MISSED COUNTS ON THE SHAPE OF POWER SPECTRA. Demenkov, V. G.; Kulabukhov, Yu. S.; Nesterenko, V. S.; Timokhin, L. A. (Physicopower Inst., Obninsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 433-436(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 90-92(1975).

The increase in the intensity of sources of nuclear particles and a number of other improvements of time-of-flight neutron spectrometers allow the rate of data acquisition to be increased and consequently allow better statistical accuracy of the measurements to be ensured. Under these conditions it becomes especially important to lower the equipment errors and specifically to eliminate the effect of the dead time of the measurement devices and the associated missed counts on the shape of the time spectrum. An analysis is given of the effect of missed counts on the shape of time spectra; two methods of correcting distortions in the shape of time spectra by means of instrumental resources are considered, and the results of an experimental check are presented. (auth)

12107 REVERSING PULSE COUNTER WITH LOW ENERGY CONSUMPTION. Eremin, A. A.; Vasyanin, A. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 450-452(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 103-105(1975).

A reversing counter with an analog and digital memory capacity of $10^4$ pulses is described which allows the difference between two sequences of statistically distributed pulses from radiation detectors to be calculated for sequential and simultaneous measurement of the minuend and subtrahend. Under these conditions smooth variation and linearization of the counter scales are possible. The accuracy of the calculations is 1 to 3%, and the power drawn is 220 mW. (auth)

12108 CALCULATED 10 TO 150 keV GAMMA-RAY EFFICIENCY VALUES FOR WELL-TYPE NaI-DETECTORS. Rieppo, R. (Oulu Univ., Finland); Blomster, K.; Holmberg, P. Int. J. Appl. Radiat. Isot.; 26: No. 9, 558-561(Sep 1975).

Efficiency values for well-type NaI detectors for extended $\gamma$-ray sources in the energy range 10 to 150 keV are given. The values for different source geometries and materials (water and bone) are tabulated. (UK)

12109 AUTOMATIC DETERMINATION OF HIGH $\alpha$-TRACK DENSITIES IN POLYMER DETECTORS. Polig, E. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Appl. Radiat. Isot.; 26: No. 9, 519-525(Sep 1975).

Two counting methods for determination of $\alpha$-track densities in solid state nuclear track detectors by means of the image analyzer Quantimet 720 are investigated and compared. The theory of geometrical probability allows to evaluate the number of tracks N in the measurement area from the expected values of the area A covered by all tracks and from the number of isolated clusters C. Both methods can be used to measure high track densities characterized by extensive overlapping of tracks. The ratio of the mean single track area and the measuring area is an essential parameter which can be assessed from a measurement of A and C. The relative error of N caused by statistical fluctuations of the overlapping process was computed from the measured relative error of A and C. It can be shown that N, when determined from A, yields a more accurate value than when computed from C. A procedure is outlined to apply automatic track counting in $\alpha$-microdosimetry of biological specimens. (auth)

12110 CHANGES IN TRANSMISSION SPECTRA OF UV-IRRADIATED PLASTIC SCINTILLATORS. Golutvina, I. G.; Zhil'tsova, L. Ya.; Matveeva, E. N.; Rubina, O. G.; Stoletova, I. M.; Shafranov, M. D. Zh. Prikl. Spektrosk.; 23: No. 1, 72-74(Jul 1975). (In Russian)

Changes in the transmission spectra of plastic scintillators irradiated by uv radiation (254 nm) and the effect of these changes on the light output of the samples were studied. (tr-auth)

12111 COMPARISON OF THE PERFORMANCES OF AN INSECT-EYE FABRY-PEROT SPECTOGRAPH AND A CLASSICAL FABRY-PEROT MONOCHROMATOR. Meaburn, J. (Manchester Univ. (UK)). Astrophys. Space Sci.; 36: No. 2, 489-493(Sep 1975).

The performance of an image-tube insect-eye Fabry-Perot spectrograph is compared to a classical Fabry-Perot monochromator when used on some topical nebular problems. A substantial gain with the IEFP over the FPM is indicated. (NL)

12112 ELECTRONIC CIRCUIT WITH ZERO DEAD-TIME FOR EXTENSION OF THE PULSE DURATION. Pomykala, W. (Silesian Technical Univ., Gliwice, Poland). Nukleonika; 20: No. 6, 581-588(1975).

Operation of noise suppression unit in the apparatus for natural $^{14}C$ activity measurements is discussed. The purpose of the circuit is to eliminate spurious pulses caused by electromagnetic disturbances. The pulse lengthening circuit with zero dead-time ensuring a correct operation of the anti-disturbance unit is described. (auth)

## Radiation Dosimeters

*Refer also to abstracts 12349 and 13789.*

**12113** (CONF-750331-2) PRECISE METHOD FOR MEASURING THE NEUTRON RESPONSE OF A NEUTRON-INSENSITIVE DOSIMETER. Kuchnir, F. T.; Vyborny, C. J.; Skaggs, L. S. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1975. 8p. (SM-193/51). Dep. NTIS $3.50.

From international symposium on advances in biomedical dosimetry; Vienna, Austria (10 Mar 1975).

By using a newly developed procedure for experimental determination of the neutron sensitivity function of a dosimeter, results were obtained for a commercially available graphite ionization chamber. The n/gamma sensitivity as a function of neutron energy from 1 to 20 MeV is presented for the air-filled chamber as well as for continuously flowing $CO_2$, $O_2$, and argon. Similar results obtained for homogeneous tissue-equivalent chambers are presented for comparison. A detailed discussion of uncertainties in the final results is presented. (auth)

**12114** (KURRI-TR-120, pp 11-15) SUPRALINEARITY OF TLD (THERMOLUMINESCENT DOSIMETRY). Nishidai, T.; Abe, M.; Toyama, S. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

Changes of the glow curves of TLD fluorescent substances were investigated and the cause of sensitivity increase was considered. An experiment on elimination of sensitivity increase was made and inversely the cause of sensitivity increase was considered. Concerning changes of glow curves of various kinds of fluorescent substances by pre-irradiation, each fluorescent substance was irradiated at various dosages and each glow curve was compared. This change is caused mainly by new trap formation due to irradiation. The rate of occurrence of sensitivity increase is proportionate to that of new trap formation. New traps of each fluorescent substance are easily formed at high temperature. Elimination of sensitivity increase was investigated from the dosage characteristic curve of each fluorescent substance. (JA)

**12115** (RISO-M-1830) NUCLEAR ACCIDENT DOSIMETRY MEASUREMENTS AT THE FOURTH IAEA INTERCOMPARISON, HARWELL, UNITED KINGDOM, APRIL 1975. Majborn, B. (Danish Atomic Energy Commission, Risoe. Reseach Establishment). Nov 1975. 24p. Dep. NTIS (US Sales Only) $3.50.

Teams from several countries compared their systems for assessing doses in criticality accidents at the fourth IAEA intercomparison at Harwell. The dosimeters were exposed to mixed pulses of neutron and gamma radiation produced by the VIPER reactor at AWRE, Aldermaston. Risø participated in the intercomparison experiment with the routine personnel dosimeters employed in "criticality areas" at Risø. These include the UKAEA criticality dosimeter for the measurement of neutron doses and the Risø TLD badge for the measurement of gamma doses. The final results of the Risø measurements are presented in a form designed for ease of comparison with those of other participants. (auth)

**12116** (UCRL-Trans-10972) DOSIMETRY OF HIGH-ENERGY (12-32 MeV) ELECTRON BEAMS WITH RADIOPHOTOLUMINESCENT GLASS. Tosi, G.; Turchi, L.; Maffi, A. Translated from Minerva Fisiconucl.; 13: 135-140(1969). 14p. Dep. NTIS $4.00.

An investigation has been carried out by the authors on the possible use of radiophotoluminescent glass for relative dosimetry of high energy intense electron beams. The betatron accelerated electron beams had energy levels ranging from 12 to 32 MeV. Silver-activated metaphosphate glass has been used in the form of 1 mm dia., 6 mm long rods. The experimental results show that in the above energy interval the glass response, at a fixed dose, is independent of energy and dose rate. When the energy is varied, the response is proportional to the absorbed dose, for doses in the range of from 15 to 20 R to 15,000 R. These results suggest that photoluminescent glass can be used as a microdosimeter for the study of high energy electron irradiation. The limitations of the method are discussed by the authors and the possible sources of error are indicated. Finally, a few suggestions are given on ways to minimize error. (auth)

**12117** COLORED INDICATOR FOR VISUALLY DETERMINING IONIZING RADIATION DOSES. Vainshtok, B. A.; Generalova, V. V.; Gursky, M. N.; Krasovitsky, B. M. (to Vsesoyuznyj Nauchno-Issledovatel'skij Inst. Fiziko-Tekhnicheskikh i Radiotekhnicheskikh Izmerenij). French Patent 2,226,671/A/. 20 Apr 1973. 12p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

According to the invention, the indicator is a film of a non-halogenated polymer containing a photoresistant luminescent coloring substance. The invention can be applied to the rapid determination of ionizing radiation doses in various technical methods. (FR)

**12118** ENERGETIC DEPENDENCE OF PLASTIC MATERIALS AS SOLID STATE TRACK DETECTORS OF FAST NEUTRONS. Spurny, F.; Lochmanova, J.; Turek, K. (Ceskoslovenska Akademie Ved, Prague. Laborator Radiologicke Dozimetrie). Radioprotection; 9: No. 4, 307-323 (1974). (In French).

The detection of fast neutrons by the registration of recoil nuclei in plastic solid state track detectors was studied. The number of heavy charged particles ($Z \geq 2$) formed by the interactions of fast neutrons in plastics (polycarbonate, cellulose triacetate, acetobutyrate and nitrate) where their tracks are etchable were calculated for several assumptions as regard the etchability of tracks. The influence of etching conditions was studied; it was very important, particularly, in the experimental conditions, the sensitivity was lower for NaOH solutions than for some other solutions. The comparison of the experimental and theoretical results showed that the tracks of $\alpha$ particles as well as recoil nuclei were etchable if their energy was higher than about 0.2 MeV. As for dosimetric applications, the detectors studied should be energetically independent for neutrons of energy between 1.3 and 14 MeV; in the experimental conditions the sensitivity in the region was $10^4$ track.cm$^{-2}$.rad$^{-1}$ for a surface removal h = 20$\mu$m. (FR)

**12119** DOSEMETER WITH A METAL-INSULATOR-SEMICONDUCTOR STRUCTURE. Digoy, J. L. (to La Radiotechnique Compelec (RTC)). French Patent 2,222,660/A/. 21 Mar 1973. 9p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

Description is given of a semiconducting device for measuring irradiation doses, this device being a MOSFET structure, field effect and insulated-gate device of revolution, with a cylindrical effective surface and ring-shaped source and drain. This can be applied to the measurement of doses up to $10^4$ rads for radiations of a few keV in the field of in-vivo biology in a flowing fluid. (FR)

**12120** ENERGY-RELEASE SPECTRA IN ROSSI COUNTERS. Keirim-Markus, I. B.; Savinskii, A. K.; Filyushkin, I. V.; Chernova, O. N. (Inst. of Biophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 415-417(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 76-77(1975).

Based on the data on the radial distribution of the energy transmitted to the medium in the cross section of charged-particle tracks, analytic relationships are derived which allow calculation of the energy-release spectra of secondary charged particles in spherical tissue-equivalent proportional counters having an arbitrary radius. (auth)

**12121** NEW SYSTEM TO REALIZE A RELIABLE THERMAL CONTACT IN TLD-SYSTEM. Ghoos, L. H. (Controle-Radioprotection, Mol, Belgium); Mertens, E.; Boulenger, R. R. Health Phys.; 29: No. 5, 785-786(Nov 1975).

A system is described whereby a firm, reliable, and easily reproducible thermal contact can be easily obtained between the LiF-teflon detector disk and the heating planchet during the routine use of TLD dosimetry systems. The detector is laid upon a heating planchet D-20 (Teledyne-Isotopes), perforated with regularly distributed holes which are in contact with the detector during heating. Below the planchet a slight lowering of pressure is maintained thus pressing the detector against the planchet. Different patterns of holes and various values of pressure have been tested. The positioning of the holes to obtain optimum results is given and results of tests with varying pressures tabulated. (UK)

**12122** STATIONARY NEUTRON MONITOR FOR CRITICALITY ACCIDENTS. Dhairyawan, M. P.; Bhatt, R. C.; Venkataraman, G.; Dayashankar. (Bhabha Atomic Energy Research Centre, Bombay). Health Phys.; 29: No. 5, 777-779(Nov 1975).

From 1st Asian Regional Congress on radiation protection; Bombay, India (15 Dec 1974).

An inexpensive stationary area monitor that can be used to estimate neutron dose is described. With this system an arbitrary quality factor for unknown spectra which can introduce serious errors is not used. The monitoring device consists of sets of fission foil irradiators in contact with mica nuclear track detectors which are placed at the centre of a polyethylene sphere of 10 in. diameter. The irradiator foils consist of alloys of natural uranium and aluminium, the amount of uranium having been chosen so that the system can measure the high dose levels that are normally encountered in criticality accidents. The use of a

solid state recorder in the system enables one to obtain a permanent record of neutron dose and the system is also insensitive to γ rays. (UK)

**12123** IMPROVEMENTS IN THE USE OF CERAMIC BeO FOR TLD. Crase, K. W.; Gammage, R. B. (Oak Ridge National Lab., TN). Health Phys.; 29: No. 5, 739-746(Nov 1975).

Several types of commercially available ceramic BeO are evaluated for thermoluminescence and combined thermoluminescence-exoelectron dosimetry (TLD-TSEE). The ceramic Thermalox 995 is superior in nearly all respects. Physical and chemical treatments which enhance or reduce sensitivity and stability of TSEE exert often similar influences on the TL. A thin surface region, which is rich in impurities, suppresses spurious emissions of both light and electrons and allows combined TL and TSEE measurements to be made on the same BeO disk. The luminescence is a maximum at 260 nm requiring a reader with a u.v.-sensitive photomultiplier tube. The characteristics important for TLD are as follows: a lower exposure limit of 1 mR with supralinearity starting at 10 R; only 10% fading after 3 months at 30°C and 90% relative humidity, but rapid bleaching in laboratory fluorescent lighting of 50% in 30 min; and an energy dependence of response similar to that of LiF TLD. (auth)

**12124** SOME LIMITATIONS IN THE USE OF PLASTIC AND DYED PLASTIC DOSIMETERS. Miller, A.; Bjergbakke, E.; McLaughlin, W. L. (Danish Atomic Energy Commission, Risoe). Int. J. Appl. Radiat. Isot.; 26: No. 10, 611-620(Oct 1975).

Several practical plastic and dyed plastic dosimeters were examined under irradiation conditions similar to those used for radiation processing of materials. Cellulose triacetate, polymethyl methacrylate, polyvinyl chloride, dyed polymethyl methacrylate, dyed cellophane and dyed nylon were given fractionated and uninterrupted absorbed doses in the megarad range with $^{60}$Co γ-rays and 10 MeV electron beams. It was found that with some systems, differences in radiation response due to dose-rate and temperature dependence can cause large systematic errors in dose interpretation. Poor reproducibility of response may result from batch-to-batch differences or intra-batch variations in thickness, distribution of sensitizers and background optical density. When using these routine dosimeters, careful calibration of the response and monitoring of factors contributing to poor reproducibility are essential. (auth)

**12125** PERSONNEL IONIZING RADIATION DOSIMETER. Williams, R. A. (to Atlantic Richfield Co.). US Patent 3,911,283. 7 Oct 1975. Filed date 8 Feb 1974. 12p.

A dosimeter and method for use by personnel working in an area of mixed ionizing radiation fields for measuring and/or determining the effective energy of x- and gamma radiation; beta, x-, and gamma radiation dose equivalent to the surface of the body; beta, x-, and gamma radiation dose equivalent at a depth in the body; the presence of slow neutron, fast neutron dose equivalent; and orientation of the person wearing the dosimeter to the source of radiation is disclosed. Optionally integrated into this device and method are improved means for determining neutron energy spectrum and absorbed dose from fission gamma and neutron radiation resulting from accidental criticality. (auth)

## Nuclear Spectroscopic Instrumentation

*Refer also to abstracts 13502 and 13670.*

**12126** (AREAEE-192) RESPONSE CHARACTERISTICS OF Ge(Li) DETECTOR FOR THERMAL NEUTRON CAPTURE GAMMA-RAY SPECTROSCOPY. Eissa, E. A.; Rofail, N. B.; El-Kady, A. A.; Hassan, A. M.; Aba-Zeid, H. M. (Atomic Energy Establishment, Inshas (Egypt)). 1974. 20p. INIS.

An external target facility at one of the horizontal experimental ports of the UA-RR-1 2 MW research reactor has been set up for thermal neutron radiative capture reactions using a true coaxial Ge(Li) detector of 30 cm$^3$ intrinsic volume. Gamma-ray spectra from standard radioactive sources as well as thermal neutron radiative capture in $^{35}$Cl, $^{54}$Fe, $^{56}$Fe and $^{1}$H were used in determining the energy-dependence, from 100 to 9300 keV, of the full-energy single-escape and double-escape relative efficiencies of our Ge(Li) detector. Response characteristics towards gamma-ray full-energy, single-escape and double-escape detection mechanisms were deduced for this detector. The results obtained can help in decomposing complex gamma-ray spectra and evaluating the intensities of the nuclear gamma-ray transitions. (INIS)

**12127** (CEA-N-1791, pp 52-55) SETTING UP THE QDDD SPECTROMETER. Bianchi, L.; Daronian, D.; David, M.; Gastebois, J.; Jusczak, F.; Lemaire, M. C. [nd]. (In French).

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The whole set was received in Saclay on March 74. The field homogeneity is better than 1/2000 in the trajectory region. The effective field boundaries have been determined in the 3 dipoles using fringing field measurements performed with Hall probes. They are within ±0.5 mm when compared to the theoretical design. The multipole components in the quadrupole lens have been measured and additive shims have been carefully adjusted to get an octupole intensity of 2.35% of the quadrupole one with the correct relative phase. The complete mounting must begin in October, and the search of focal position is planned for January 1975. (FR)

**12128** (CEA-N-1791, pp 55-56) DETECTION SYSTEM FOR THE QDDD FOCAL SURFACE. Chamaux, E.; Fouan, J. P.; Mathieu, L.; Ngo-Tich, P. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Small (l ≈ 30 cm) prototypes of needle + helix and multidrift counters were built and tested. The design of a 2 m long shadowless curved system is under development. (FR)

**12129** (PAEC(D)-7326) STABLE VOLTAGE REGULATORS FOR INSTRUMENTATION DEVELOPMENT. Calix, V. M.; Navarro, Q. O. (Philippine Atomic Energy Commission, Manila). Jun 1973. 13p. INIS.

A practical approach in designing a low cost but stable and versatile transistorized voltage regulator circuit is presented. It includes the detailed circuit theory of operation and important output characteristics. The fabricated unit incorporating the developed circuit supplies 12 watts and 800 mW of power with terminal voltages of ± 12 and ± 15-volt respectively. (INIS)

**12130** EXPERIMENTS WITH FILTERED NEUTRON BEAMS. Greenwood, R. C. (Idaho National Engineering Lab., Idaho Falls). pp 323-340 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd International symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920–.

The following topics are discussed: (1) how to obtain high fluxes of essentially monoenergetic neutrons having keV energies with a reactor, in such a way that they are usable for (n, γ) studies, (2) why such filtered neutrons are valuable for nuclear spectroscopic studies using the (n, γ) technique, and (3) non-statistical neutron capture effects with such filtered neutrons. (auth)

**12131** LARGE ANGLE OPTICAL INTERFEROMETER FOR A CRYSTAL SPECTROMETER. Schwitz, W.; Kern, J. (Univ., Fribourg, Switzerland). pp 697-701 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd International symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920–.

A laser interferometer for precise angle measurements has been developed for the crystal spectrometer of the University of Fribourg. The angular range is ± 20°. The apparatus has been tested with five γ-ray transitions in the decay of $^{169}$Yb. The angular precision is shown to vary between 5 and 29 msec of arc in the tested range of ± 10°. The relative precision obtained for the 307 keV transition is 0.24 ppm. (auth)

**12132** NUMERICAL REFERENCE LINE METHOD IN CRYSTAL DIFFRACTION SPECTROMETRY. Kern, J.; Dubler, T. (Univ., Fribourg, Switzerland). pp 702-705 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd International symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920–.

A method for the analysis of spectra from crystal diffraction spectrometers is described. The numerically given left reflex, taken as reference, is shifted by steps and amplified until the best overlap, in the least-squares sense, with the corresponding right reflex is obtained. The magnitude of the shift is equal to twice the Bragg angle. A method for the computation of errors is presented. (3 figures) (auth)

**12133** CONVERSION ELECTRON SPECTROMETER BILL AT THE HIGH FLUX REACTOR IN GRENOBLE. Mampe, W. (Institut Laue–Langevin, Grenoble, France); Maier, B.; Jeuch, P.; Larysz, J.; Braumandl, F.; von Egidy, T. pp 709-711 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd International symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920–.

A new high resolution iron spectrometer BILL (Beta-spectrometer at the Institut Laue-Langevin) for neutron capture conversion electrons is now operational in combination with the high flux reactor in Grenoble. The energy range is E = 30 keV-10 MeV. The best measured FWHM resolution is $\Delta P/P = 2 \times 10^{-4}$. (auth)

**12134** MAGNETIC SUSPENSION AND ITS APPLICATION IN TIME-OF-FLIGHT REACTOR NEUTRON SPECTROSCOPY. Kalebin, S. M. (Inst. for Theoretical and Experimental Physics, Moscow). pp 712-717 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd International symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A number of features related to the spatial position stability of rotors suspended in a magnetic field are discussed. Some parameters of the magnetic suspension are given which enable one to understand its use in different devices, and particularly in time-of-flight neutron spectroscopy at the reactor related to (n,γ) measurements. (auth)

**12135** HIGH PRECISION MEASUREMENT OF A FORWARD-BACKWARD ASYMMETRY IN $\beta-\gamma$ DIRECTIONAL CORRELATIONS. Dydak, F.; Polaschegg, H. D.; Riehs, P.; Serentschy, G.; Weinzierl, P. (Inst. of Physics, Seibersdorf, Austria). pp 722-726 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd International symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

An apparatus for the measurement of extremely small $A_1$ coefficients in $\beta-\gamma$ directional correlations is described. The advantages of a multiple detector arrangement, the mechanical precision requirements and the source preparation are discussed as well as a new technique for the evaluation of the data. (auth)

**12136** MOESSBAUER SPECTROSCOPY OF $^{57}Fe$ AND $^{119}Sn$ BY DETECTION OF CONVERSION AND AUGER ELECTRONS; APPLICATION TO SURFACE STUDIES. Schunck, J. P.; Friedt, J. M.; Llabador, Y. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Lab. de Chimie Nucleaire). Rev. Phys. Appl.; 10: No. 3, 121-126(May 1975). (In French).

A system which allows the measurements of Moessbauer spectra as a function of the energy of conversion and Auger electrons was built. Because of the low range of electrons in a solid Moessbauer spectroscopy deals only with a thin surface layer of the sample (0.3μ for $^{57}Fe$ and 3μ for $^{119}Sn$). Monochromatic electrons are emitted and the loss of their energy is related to the depth of material they come from. Selecting the electrons in terms of their energy with the use of a β spectrometer thus allows an analysis of layers of known thickness and depth. Some examples of application on iron and tin samples are described. (FR)

**12137** SIMULATION AND REAL TIME ACQUISITION FOR CALIBRATING SPACE ASTRONOMICAL INSTRUMENTS. Perrin, J. M. (Centre National de la Recherche Scientifique, 13-Marseille (France). Lab. d'Astronomie Spatiale). ELDO/ESRO Sci. Tech. Rev.; 7: No. 1, 75-83(1975). (In French).

The real-time simulation and acquisition equipment at the Laboratoire d'Astronomie Spatiale is presently arranged for the automatic calibration of three astronomical instruments on board the D-2B satellite. After a functional description of these instruments and a review of the calibration methods, the real-time simulation and acquistion equipment, its functions and performance are discussed. The software for running this equipment is then described, together with the major difficulties encountered during the programming and operational stages. (FR)

**12138** A FORTRAN CODE FOR AUTOMATIC SPECTRUM ANALYSIS ON MEDIUM-SCALE COMPUTERS. von Meerwall, E. D. (Department of Physics, The University of Akron, Akron, Ohio, USA). Comput. Phys. Commun.; 9: No. 6, 351-359(Jun 1975).

The program performs fully automatic detection, description, and fitting of peaks (including doublets) in digital X-Y spectra of various kinds, given only an approximate width, and the choice of positive or negative (absorption) height, of the peaks. Peak detection is performed by additive convolution with a zero-area function. The peak region just detected is conventionally described and its singlet or doublet nature decided. Gaussian or lorentzian peak region fit after background subtraction is performed; in the doublet case the fit is iterative. Spectral smoothing before, and plotting after, processing are available; spectra are processed automatically in a single pass. The emphasis on economic use of memory is retained. (auth)

**12139** DISCRETE CONTROLLER FOR CONTROLLING THE SPEED OF ROTATION OF A MECHANICAL NEUTRON SELECTOR. Golovin, A. E. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 379-381(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 47-49(1975).

A discrete controller for controlling the rotation speed of a mechanical neutron selector fabricated using an industrially manufactured thyristor converter of the TPCh-15 type is described. A stability of the speed of rotation equal to 0.1% is obtained in the range from 1000 to 12,000 rpm. (auth)

**12140** NARROW NEUTRON BEAM SPECTROMETER FOR MEASUREMENT OF TRANSMISSION OF SMALL SPECIMENS. Razbudei, V. F.; Vertebnyi, V. P. (Inst. of Nuclear Physics, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 382-384(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 50-52(1975).

A flight time spectrometer with neutron beam 0.17 mm in diameter is described. The device is intended for measurement of total neutron cross section of radioactive isotopes in the energy range 0.01 to 0.3 eV. (auth)

**12141** SEMICONDUCTOR BETA SPECTROMETER WITH A HIGH ENERGY RESOLUTION. Vasil'ev, S. K.; Vylov, Ts.; Osipenko, B. P.; Yurkovski, Ya. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 385-390(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 52-57(1975).

A spectrometer with Si(Au) and Si(Li) detectors for investigating the spectra of converging electrons and low-energy γ quanta is described. An energy resolution of 900 eV is obtained for electrons having an energy of ~30 keV (decay of $^{147}Eu$) and for 440 eV for γ quanta having an energy of approximately 12 keV (decay of $^{241}Am$). (auth)

**12142** INSTRUMENTAL FUNCTION OF A SCINTILLATION SPECTROMETER HAVING A LARGE NaI(Tl) CRYSTAL. Gurevich, G. M.; Mazur, V. M.; Solodukhov, G. V. (Inst. of Nuclear Research, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 394-397(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 59-62(1975).

The inverse-matrix method is used to obtain the instrumental function of the scintillation spectrometer. The measurements were carried out for maximum bremsstrahlung energies ranging from 4 to 27 MeV. A procedure for smoothing the experimental data is described. The matrix of the instrumental function is presented. (auth)

**12143** EQUIPMENT CONTRACTION OF COMPTON DISTRIBUTION IN A HIGH-RESOLUTION GAMMA SPECTROMETER. Gonchar, A. I.; Kham'yanov, L. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 429-432(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 87-89(1975).

The possibility is demonstrated of suppressing the Compton background in the instrumental spectrum of a γ-radiation source by smoothing the total-absorption peaks using special instrumental perturbation and subtracting the smooth spectrum from the original one. The schematic of a generator producing instrumental perturbation with an equiprobable distribution density is presented. (auth)

**12144** TWO-AREA-METHOD FOR EVALUATING SCINTILLATION GAMMA SPECTRA BY CALIBRATED PEAK FRACTIONS. Steger, F. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Seibersdorf, Austria); Hefner, A.; Schoenfeld, T. Int. J. Appl. Radiat. Isot.; 26: No. 10, 626-629(Oct 1975).

A method of evaluating the base areas from the data on a large number of peaks, in the evaluation of γ spectrum obtained with a whole-body counter, is demonstrated. These evaluations are carried out by the "two-area-method". Standard deviations for evaluations carried out by this method are seen to be about half as large as those for evaluations by a similar method proposed by Covell (Analyt. Chem.; 31: 1785 (1959)). (UK)

## *High Energy Physics Instrumentation*

*Refer also to abstract 12754.*

**12145** (CEA-N-1791, pp 106-107) TESTING MOUNTING OF INTERPOLATION MULTIWIRE PROPORTIONAL CHAMBERS. Bricaud, B.; Chaminade, R.; Durand, J. M.; Faivre, J. C.; Pain, J. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973-30 September 1974.

The last results obtained for multiwire proportional chambers on the test beam at Saturne show a resolution of 0.6 mm FWMH with a detection efficiency of 98% at 50 ns coincidence width. (FR)

**12146** (CEA-N-1791, pp 172-175) NEEDLE CHAMBER FOR HEAVY ION DETECTION. Grunberg, C.; Le Devehat, J. [nd]. (In French).

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A prototype of a fully transparent counter, resulting from a combination of a drift chamber and a needle chamber, is described. Only preliminary results are given and must be considered as orders of magnitude in lieu of more accurate measurements. (FR)

**12147** (CEA-N-1791, pp 176) STUDY OF A RANGE TELESCOPE FOR 100 MeV PROTONS. Argan, P.; Audit, G.; Bechade, J.; de Botton, N.; Bloch, A.; Faure, J. L.; Laget, J. M.; Schuhl, C. G.; Tamas, G. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A range detector used to measure proton energies in 40 to 250 MeV energy with about 2 MeV energy resolution is described. (FR)

**12148** (LBL-4255) PICOSECOND OPTICAL SHUTTER FOR PARTICLE DETECTION. Fan, B.; Gee, C. M.; Shapiro, G. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Apr 1975. Contract W-7405-ENG-48. 26p. Dep. NTIS $5.00.

Characteristics of an optical shutter utilizing Kerr effect induced by picosecond laser pulses in carbon disulfide are studied experimentally. The shutter has a gate time of 4.5 to 5 ps full width at half-maximum and a transmission of approximately 15 percent at a wavelength 0.53 mu m. Such an ultrafast shutter can be used as an optical signal gate in a sampling detection scheme that has picosecond time-resolution. The picosecond optical detection scheme is envisioned to have applications in experimental high-energy physics such as to time-resolve ultrashort Cherenkov or synchrotron radiation emitted by relativistic particles. Methods of synchronizing a laser-activated Kerr shutter with a particle accelerator or synchrotron are discussed. (auth)

**12149** NEW DEVELOPMENTS IN TRANSITION-RADIATION DETECTORS FOR HIGH-ENERGY PARTICLES. Yuan, L. C. L. (Brookhaven National Lab., Upton, N. Y. (USA); European Organization for Nuclear Research, Geneva (Switzerland)). ELDO/ESRO Sci. Tech. Rev.; 7: No. 1, 53-59(1975).

A review of some recent technical developments in transition-radiation detectors is given, and both existing detection methods and some involving quite novel techniques are described. Good separation of pions from protons at 100 to 250 GeV can be achieved by employing radiator-wire chamber systems. Novel methods utilizing superconducting grains and thin scintillation foils for the detection of transition radiation are also described. (FR)

**12150** SHOWER SPECTROMETERS AND RADIATORS CONSISTING OF SOLUTIONS OF THALLIUM SALTS. Varfolomeev, A. A.; Glebov, V. I.; Denisov, E. I.; Khlebnikov, A. S. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 391-393(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 57-59(1975).

The possibility of using the Clerici solution for fabricating shower spectrometers was investigated. Data are presented on the transparency of the solution. A shower spectrometer consisting of the Clerici solution is described which was tested using electron beams having an energy of 3 to 48 GeV. A method is proposed for increasing the light intensity of the shower spectrometer by placing thin scintillator plates into the transparent radiator. The advantages of such a transparent sandwich over conventional sandwiches (having nontransparent radiator layers) are considered. The results of measuring the luminescence yield of a stratified radiator consisting of the Clerici solution are presented. (auth)

**12151** SCINTILLATION COUNTER 100 cm LONG FOR MEASUREMENT OF IONIZATION LOSSES OF RELATIVISTIC PARTICLES. Astvatsaturov, R. G.; Ivanov, V. I.; Knapik, E.; Kramarenko, V. A.; Kulakov, B. A.; Malakhov, A. I.; Melkumov, G. L.; Khachaturyan, M. N. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 398-400(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 62-65(1975).

A scintillation counter is described which is fabricated from a plastic scintillator 100 cm long. The amplitude resolution of the counter, measured on a beam of relativistic particles, is equal to 50%. (auth)

**12152** AUTOMATICALLY CONTROLLED HELIUM SPARK DETECTOR FOR RECORDING SHORT-RANGE PARTICLES. Kayumov, F. F. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 406-407(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 69-70(1975).

A spark apparatus for recording short-range $\alpha$ particles starting and stopping in gas is described; it comprises a multiwire proportional counter between two spark chambers with a common gas filling (He + $CO_2$ + $H_2O$). (auth)

**12153** AMPLITUDE STABILIZATION OF HIGH-VOLTAGE PULSES USING POWERFUL COMMUTATORS. Matyushin, A. T.; Matyushin, V. T.; Pak, V. S.; Rudenko, N. S.; Smetanin, V. I.; Tsvetkov, V. I. (Scientific-Research Inst. of Nuclear Physics, Electronics, and Automation, Tomsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 469-471(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 118-119(1975).

The problem of amplitude-stabilizing high-voltage pulses may arise, for example, in connection with the feeding of streamer chambers or in satisfying the more stringent demands made upon the electron-beam parameters of nanosecond accelerators. The characteristics of three forms of discharge gaps are examined in order to establish the possibility of creating amplitude-stable high-voltage pulses. An amplitude stability of ~2% or better may in fact be obtained from one pulse to another. (auth)

**12154** COAXIAL BLUEMLEIN LINE FOR SHAPING NANOSECOND HIGH-VOLTAGE PULSES. Artem'ev, V. A.; Knyazev, V. M.; Luzhetskii, N. N.; Nikolaev, V. P.; Pershin, I. I.; Rechitskii, I. V. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 472-474 (1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 120-122(1975).

A simple construction of a coaxial double shaping line (d.s.l.) designed for supplying a streamer chamber is described. The spark gap of the d.s.l., which was formed by two stainless steel rings, was filled with $SF_6$ gas under an elevated pressure and operated in the overvoltage regime. The characteristics of the d.s.l. were investigated when it was filled with caster oil and $SF_6$ for a fixed gap size in a spark gap of 8 mm. When the d.s.l. is filled with $SF_6$ it shapes a pulse having a length 5.0 ± 0.1 nsec with a rise time <0.9 ± 0.1 nsec and an amplitude of 450 kV. The pulse-amplitude instability measured from oscillograms amounted to $(\Delta U/U)$~5% and was basically caused by the sensitivity limit of the measurement equipment. (auth)

**12155** TRANSITION RADIATION FROM HIGH ENERGY PARTICLES. Michelson, L. P. Garden City, NY; Adelphi Univ. (1975). 145p. University Microfilms Order No. 75-15,180.

Thesis (Ph. D.).

The properties of x-ray transition radiation from high-energy particles were investigated. The attractive Lorentz factor dependence of x-ray transition radiation suggests that it might be used for the purpose of particle identification at energies above which conventional Cherenkov detectors are useful. Radiators were constructed of 100 uniformly spaced 1-mil aluminum foils with air gaps ranging from 1 to 170 mils. Measurements were taken with each radiator at primary energies of 6.0, 8.0, and 9.8 GeV. The radiation was detected by using a lithium-drifted germanium detector. A simulation, based on theoretical consideration, of the experimental data was carried out by using Monte Carlo techniques. The simulation took account of all relevant aspects of the experimental generation and detection processes. Comparison of experimental and theoretical results revealed excellent agreement in the distribution in energy of deposition in the Ge(Li) detector and in total energy deposition for all radiators and primary energies investigated. Total deposition was found to rise to an asymptotic value with foil spacing. The success of the theory should allow the design of transition radiation systems (TRD) optimized to a specific task without having to resort to empirical methods. TRD systems will find application in accelerator and cosmic ray experiments. TRD's are being incorporated in several high-energy physics experiments and these experiments are also discussed. (Diss. Abstr. Int., B)

**12156** TIMING SCINTILLATION COUNTER TYPE 1052 CAMAC. Cisek, Z.; Ogorkiewicz, R.; Gasik, W. Nukleonika; 20: No. 6, 557-571(1975).

A timing scintillation counter (system CAMAC–type 1052) is described. Series of measurements have been performed with it at the Dubna Synchrocyclotron (JINR, Dubna, USSR), where meson beams were measured and by the use of a simulating system consisting of LED. The results obtained are presented. The time resolution obtained for large amounts of light (output pulses amplitude distribution ~10%) is equal to 200 ps and the time spread middle point shift approaches to ±25 ps (due to high pulsating intensities on the simulating diode). The mean anode current of the photomultiplier is equal to 0.5 mA (for high intensities applied during measurements), and this is considered as an equivalent of the mean frequency ranging about 70 MHz for trigonal pulses with the base time duration of 15 ns and the ampli-

tude of 50 mV on a 50-ohms resistor. A telescope composed of two scintillation counters gave a time resolution of $2\Delta\tau = 280$ ps ±3% for a $\pi$-mesons beam and this value was accompanied by an energy loss in the scintillator on the level of 4 MeV. (auth)

## Radiometric Instruments

*Refer also to abstracts 12050, 12051, 12056, 12196, and 13453.*

**12157** THE APPLICATION OF RADIONUCLIDES IN TECHNOLOGY. Seda, J. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska). Jad. Energ.; 20: No. 10, 341-347(Oct 1974). (In Czech).

94 refs.

Main trends are outlined of radionuclide applications in Czechoslovak technology since the introduction of the industrial use of radionuclides to the present time. Attention is focused on the application of sealed sources. The methods of thickness, level, density, and moisture measurements, various analytical methods etc. are reviewed. The optimization of measuring methods and the correction for interfering effects are dealt with. (auth)

**12158** PROCESS FOR SPECTROSCOPY INVESTIGATION OF A PROBE HOLE BY $\gamma$ RADIATION. (to Texaco Development Corp.). French Patent 2,224,766/A/. 6 Apr 1973. 31p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The procedure consists in utilizing 14-MeV neutron pulses to excite elements placed around a probe hole. A scintillation detector is excited at the end of a period of predetermined duration after each pulse coming from the source in order to detect $\gamma$ rays resulting from capture in the ground formation of thermal neutrons from the source. The resulting $\gamma$ spectrum is compared with a composite spectrum consisting of a weighted melange of standard spectra by the least squares technique. It is applicable to the determination of ground formations around a bore hole. (tr-FR)

**12159** METHOD FOR DETERMINING THE MASS OF AN OBJECT AND THE POSITION OF ITS CENTER OF GRAVITY, AND THE CORRESPONDING DEVICE. Csakvary, E.; Pascal, A. (to CEA). French Patent 2,222,642/A/. 19 Mar 1973. 19p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to a method for determining the mass of an object and the position of its center of gravity, and to the corresponding device. According to the invention, the object is scanned by a pencil of X- or $\gamma$ electromagnetic radiation, and the mass of the thus- scanned volume is derived from the pencil absorption. This can be applied to mechanics or medicine. (FR)

**12160** DENSITY MEASUREMENT BY MEANS OF RADIOMETRIC INSTRUMENTS IN THE DRESSING OF KAOLIN. Henker, W. (VEB RFT Messelektronik Otto Schoen, Dresden (German Democratic Republic)). Chem. Tech. (Leipzig); 26: No. 11, 720-722(1974). (In German).

A modified surface density gauge VA-T-77 is established based on $^{137}Cs$ $\beta$-particle absorption. The device is useful for density and solid content measurements under industrial conditions. (INIS)

**12161** NEUTRON LIFETIME WELL LOGGING METHODS AND APPARATUS. Paap, H. J.; Pitts, R. W. Jr. (to Texaco Inc.). US Patent 3,914,603. 21 Oct 1975. Filed date 17 Dec 1973. 18p.

A well logging system is described in which a modulated high energy neutron source is utilized in a well bore to develop an intensity modulated cloud of thermal neutrons as a function of time in the surrounding media. The phase angle of the thermal neutrons is determined relative to the generated high energy neutrons from the neutron source. The formation thermal neutron decay time or neutron lifetime which is a function of type of formation materials, is derived from the phase angle measurement. Electronic systems are provided for computing formation phase angle measurements of thermal neutrons from neutron and gamma ray counts made as a function of time and which are detected by a downhole logging tool. A recording, as a function of depth, is made of the thermal neutron decay time or neutron lifetime values and/or the related thermal neutron macroscopic capture cross-section values. (auth)

## Radiation Effects on Instrument Components, Instruments, or Electronic Systems

*Refer also to abstracts 11817, 11822, and 11837.*

**12162** EFFECTS OF NEUTRON IRRADIATION ON THE NOISE OF JUNCTION FIELD-EFFECT TRANSISTORS. Wang, K. H. Gainesville, FL; Univ. of Florida (1975). 114p. University Microfilms Order No. 75-23,922.

Thesis (Ph. D.).

A study is presented of the electrical noise properties of junction field-effect transistors subjected to neutron irradiation. Selected devices were exposed to both fast and thermal neutrons in the University of Florida Training Reactor. It is shown that such irradiation gives rise to a number of defects both in the channel and in the depletion layer of the gate-channel junction. The noise spectra of irradiated devices exhibit much structure due to the generation-recombination involving these defects. From measurements down to cryogenic temperatures, the lifetimes and activation energies of the defects could be deduced. The noise spectra are interpreted with the aid of a modified theory concerning depletion layer generation-recombination noise. Other types of noise theory, pertaining to channel defects are also considered. From the energy levels of the defects and the effects of annealing temperature on the noise, information was obtained to classify and identify some of the defect centers. (Diss. Abstr. Int., B)

## Miscellaneous Instruments

*Refer also to abstracts 11904, 11905, 12760, and 12899.*

**12163** (AWRE-O-36/75) DEVELOPMENT OF A TIME OF FLIGHT DIFFRACTOMETER, FIONA. Goodyear, A. G.; Miller, R. J. R. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Nov 1975. 29p. Dep. NTIS (US Sales Only) $5.00. UK 50 pence.

A neutron diffractometer, FIONA, has been built at AWRE in order to study structure and equation of state data of materials at high pressures and elevated temperatures. It is required that the sample should be subjected to pressures up to 60 kbar (1 kbar = 100 MN/m$^2$) and temperatures up to 800°K. There is a further requirement that the diffractometer should have a multi-detector system to make the maximum use of the neutrons available from the 5 MW HERALD reactor. Both these requirements can be met by using a time of flight diffractometer. (auth)

**12164** (CEA-CONF-2935) COMPATIBILITY WITH GRAPHITE OF CERTAIN REFRACTORY METALS AND ALLOYS USED FOR THERMOCOUPLE SHEATHING AT HIGH TEMPERATURES. Schley, R.; Gentil, J.; Metauer, G. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Technologie). 1974. 7p. (In French). INIS.

From international colloquium on high-temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

Various methods are used to study the problems raised by the contact of niobium, molybdenum and rhenium with graphite at high temperature, and the extent to which these materials can be used to sheath thermocouples intended for temperature measurements in graphite is assessed. In the case of Inconel the role of tungsten and titanium as protective coating is investigated. (FR)

**12165** (CEA-CONF-2937) NEW THERMOCOUPLES FOR THE MEASUREMENT OF TEMPERATURES ABOVE 1000°C. Schley, R.; Liermann, J.; Metauer, G.; Gentil, J. .(CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Technologie). 1974. 7p. (In French). INIS.

From international colloquium on high-temperature in-pile thermometry; Petten, Netherlands (12 Dec 1974).

In view of the problems posed by the in-pile use of tungsten/rhenium thermocouples the possibilities of molybdenum/niobium and platinum/platinum–molybdenum thermocouples are considered. In the former case the electromotive force of the thermocouple is studied, a calibration curve is established, the effect of adding molybdenum in the negative branch of the thermocouple is examined and alloys able to provide compensation from 0 to 300°C are determined. (FR)

**12166** (CEA-N-1791, pp 177-181) ELECTRONIC EQUIPMENT. New Functional Units in NIM Standard. Cheminaud, J.; Grasso, G.; Lacroix, C.; Le Baud, P.; Pichot, G.; Poirot, L. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

During the year 1974 some new modules have been developed: (i) a tele-control for delay-time which utilizes a multiplexer-demultiplexer; (ii) a fast pulse generator for light-emitting diodes which allows the test of devices using photomultipliers; (iii) a plug-in-unit of variable shaper for fast pulses, with reset and

zero dead time; (iv) an amplifier with a 50 MHz band-pass and an adjusting amplification from 0 to 10; (v) a pocket generator delivering NIM pulses. (FR)

**12167** (CEA-N-1791, pp 202-203) ELECTRONIC COUPLING DEVICE FOR PLOTTERS. Libourel, P. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A coupling device was designed to drive an incremental plotter while the computer is busy with tasks of higher priority. (FR)

**12168** (PAEC(D)-7331) MAGNETIC FIELD MODULATOR FOR NMR SPECTROMETER. Calix, V. M.; Navarro, Q. O. (Philippine Atomic Energy Commission, Manila). 23 Sep 1973. 16p. INIS.

Traversing the whole resonance curve in a relatively short time is necessary to provide a modulated signal which has the advantage of easier amplification and also enables the use of narrow bandwidth detector with the corresponding improvement in the signal-to-noise ratio. The simplicity of sweeping the d.c. magnetic field while maintaining the r-f frequency constant is adaptable in our effort to build an NMR spectrometer for simple proton resonance experiments. The sweep amplifier presented accepts sine, triangular, and ramp input voltages with a maximum output power of 20 watts. (INIS)

**12169** (UCRL-50025-75-4, pp 11-13) AUTOMATIC CALIBRATION SYSTEM SAVES TIME, IMPROVES ACCURACY. 8 Oct 1975.

In Electronics Engineering Department quarterly report No. 4, 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

It no longer takes days to check out and calibrate the multitude of digital data-gathering instruments at the Nevada Test Site. The EE Department's Field Test Division has installed a new computer-controlled calibration system that does the job much faster, more accurately, and with automatic documentation of results. A description of this system is given. (auth)

**12170** (UCRL-50025-75-4, pp 17-19) LASER PULSETRAIN USED TO MEASURE SUBNANOSECOND APERTURE TIMES OF PULSED IMAGE INTENSIFIERS. 8 Oct 1975.

In Electronics Engineering Department quarterly report No. 4, 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

A simple technique for measuring subnanosecond aperture times of pulsed image-intensifier tubes is described. Exact aperture-time information is often needed to diagnose image-intensifier data on fast, transient events. The new method uses the pulsetrain of a modelocked dye laser as the timing source, rather than a single timing pulse, to minimize the jitter and synchronization problems inherent in such fast time measurements. (auth)

**12171** (UCRL-50025-75-4, pp 23-25) EE-DEVELOPED FRAMING CAMERA ADDS NEW DIMENSION TO LLL's HIGH-SPEED-PHOTOGRAPHY CAPABILITY. 8 Oct 1975.

In Electronics Engineering Department quarterly report No. 4, 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

The EE Department has greatly expanded the Laboratory's high-speed-photography capability by developing a very high-speed image-converter-tube (ICT) framing camera. This sequential, multiframe camera system, the first of its kind, can photograph high-explosive events with greater speed, image resolution, and versatility than ever before possible. It is a selectable-optic system using eight ICTs that can be shuttered simultaneously or separated by preset time delays, all with nanosecond accuracy. Another unique feature is the camera's ability to take "stereo" pictures (coincident photos from different angles), thus adding depth perception to the film record of the event being investigated. (auth)

**12172** FUNCTION OF A CYLINDRICAL LANGMUIR PROBE IN A MOVING PLASMA CONTAINING NEGATIVE IONS. Ragab, F. M. (Univ. of Tripoli, Libya). Acta Phys. Acad. Sci. Hung.; 38: No. 3, 225-231(1975).

An investigation of the collection of current of different charged particles by a moving cylindrical probe is outlined. The required volt–ampere relations are derived for the case when the probe potential retards both electrons and negative ions. The theoretical work is extended to the case of a plasma with a superimposed drift when positive ions are retarded by a positive probe potential. It has been proved that the collected ion current depends strongly on the drift velocity and on the angle between the axis of the probe and the velocity vector. In general, the cylindrical Langmuir probes prove to be a good tool in studying ionospheric ion mass spectra and temperature together with electron temperature since they avoid most of the difficulties incurred in using any other form of probes. At the same time, the derived relations could be extended to study the energy distribution function for any species of charged particles. (auth)

**12173** CURRENT STATE OF THE CAMAC STANDARD. Kolpakov, I. F.; Smirnov, V. A.; Khemelevskii, E. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 329-337(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 7-16(1975).

A survey is presented of the papers at the First International Symposium on the application of the CAMAC system with real-time computing, which was held in Luxembourg on December 4-6, 1973; the current state of the CAMAC system is discussed together with applications and software on the basis of papers and discussions at the symposium. (auth)

# ISOTOPE AND RADIATION SOURCE TECHNOLOGY

## Isotope Separation (Industrial)

*Refer also to abstracts 11517 and 13964.*

**12174** (INIS-mf-1689) ELECTROMAGNETIC SEPARATION OF IODINE ISOTOPES WITH THE AID OF NEGATIVE IONIZATION AND THE STUDY OF THEIR DISTRIBUTION IN THERMAL NEUTRON FISSION OF $^{235}U$. Venezia, A. (Hebrew Univ., Jerusalem (Israel)). Aug 1973. 133p. (In Hebrew). INIS. English resume.

Iodine nuclides, produced during the thermal neutron fission of uranium-235, were separated, identified and determined, using an isotope separator, working on-line with a fissioning source. Iodine nuclides were separated and measured by a new technique, based on negative surface ionization of fission-produced iodine. The separation was performed in an electro-magnetic mass separator, in which the elemental separation between isobars is effected with the aid of a specially designed ion source. (INIS)

**12175** (K-M-6124) GASEOUS DIFFUSION OPERATIONS. Sommerfeld, K. W. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). 1975. 25p. (CONF-751145-1). Dep. NTIS $4.50.

From uranium enrichment conference; Oak Ridge, Tennessee, USA (11 Nov 1975).

The explanations accompanying a series of slides to represent pictorially gaseous diffusion plant operation are presented. The slides were selected to describe sequentially the normal series of steps that occur when feed is shipped to a diffusion plant and moves through the various auxiliary steps prior to entering the separation cascade. They also include the activities normally associated with product withdrawal and customer shipment. (JSR)

**12176** (UCRL-Trans-10963) PROCEDURE FOR ISOTOPE ENRICHMENT. Levy, R. H. Nov 1975. Translation of Belgian Patent No. 807,118. 26p. Dep. NTIS $5.00.

A method for separating $^{235}U$ and $^{238}U$ by selective ionization is described. (LK)

**12177** (UCRL-Trans-10964) PROCEDURE AND DEVICE FOR THE SEPARATION OF AN ISOTOPE BY SELECTIVE IONIZATION. Kantrowitz, A. Nov 1975. Translation of Belgian Patent No. 807,442. 21p.

A procedure for the separation of isotopes by selective ionization and which efficiently uses an isotope source is described. A promising technique for higher yield separation of the $^{235}U$ isotope includes selective ionization of this isotope in uranium vapor, without a concomitant ionization of the $^{238}U$ isotope present in the vapor. (LK)

**12178** PROCESS AND DEVICE FOR THE ENRICHMENT OF FLUIDS. (to Deuterium Corp.). French Patent 2,176,529/A/. 22 Mar 1972. 19p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

An enrichment device with two sources of heat is described. It can increase the deuterium content in water from a concentration of 1 mol% to 99.8 mol%. The device also assures the final treatment of the product with removal of the dissolved impurities. The product has a high purity. (tr-FR)

**12179** PROCESS OF CONCENTRATION BY EXCHANGE BETWEEN FLUIDS AT DIFFERENT TEMPERATURES. (to Deuterium Corp.). French Patent 2,176,530/A/. 22 Mar 1972. 38p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

An installation for the production of heavy water is described in which several concentration apparatus are mounted in parallel. This permits an increase of the capacity of the installation by a multiplication of the apparatus of a single enrichment stage. (tr-FR)

**12180** DEVICE FOR THE TREATMENT OF FEED AND RECUPERATION FLUIDS IN A PLANT FOR THE PRODUCTION OF HEAVY WATER. (to Deuterium Corp.). French Patent 2,176,532/A/. 22 Mar 1972. 16p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention concerns devices for the processing of evacuated fluids and exchange devices for material from two sources at different temperatures. It consists of an installation which receives sea water and supplies it, after heating, to a material exchange furnace. The effluent from the furnace is treated in such a manner that the apparatus recovers the heat of the hydrogen sulfide dissolved in the evacuated water. This procedure is applicable to the processing of feed water and evacuated water from an installation for heavy water productions. (tr-FR)

**12181** CARBON ISOTOPE SEPARATION BY TUNABLE-LASER PREDISSOCIATION OF FORMALDEHYDE. Clark, J. H.; Haas, Y.; Houston, P. L.; Moore, C. B. (California Univ., Berkeley (USA). Dept. of Chemistry). Chem. Phys. Lett.; 35: No. 1, 82-85 (15 Aug 1975).

Separation of carbon 12/13 isotopes has been achieved by selective predissociation of formaldehyde using a frequency-double dye laser. The enrichment factor for pure formaldehyde samples is less than expected from spectroscopic data but is greatly improved by the addition of NO. Starting from a 1:10 mixture of $^{12}CH_2O:^{13}CH_2O$ an eighty-fold enrichment in $^{12}CO$ has been obtained. (auth)

**12182** CUSTOM ENRICHMENT OF URANIUM. Vesely, V.; Pesek, V. Jad. Energ.; 20: No. 11, 387-390(Nov 1974). (In Czech).

Prices are discussed of the custom enrichment of uranium as light-water reactor fuel. The theoretical determination of the optimum price is based on the relations between the price of uranium, the cost of enrichment, the degree of enrichment, and the $^{235}U$ concentration in the depleted residue. (INIS).

## Isotopic Power Sources

*Refer also to abstract 12563.*

**12183** (BNWL-1845-16) PACIFIC NORTHWEST LABORATORY QUARTERLY REPORT TO USERDA ADVANCED NUCLEAR ENERGY SYSTEMS, SPACE AND SPECIAL PURPOSES DIVISION, FOR JULY-SEPTEMBER 1975. Fullam, H. T.; Harmon, K. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Oct 1975. Contract E(45-1)-1830. 20p. Dep. NTIS $4.00.

Progress during July to October 1975 in research on radioisotope heat sources is reported. The design of the long-term $^{90}SrF_2$ compatibility tests has been finalized. The effect of thermal aging on the impact strength of Hastelloy C-4 is being evaluated using Charpy test specimens. The solubility of $SrF_2$ in seawater and demineralized water was determined at 23°C. The equilibrium concentration of Sr in demineralized water is greatly influenced by the presence of fluoride impurities in the $SrF_2$, whereas in seawater the presence of fluoride impurities has little effect on the Sr concentration. The effect of impurity fluorides and decay product ($ZrF_4$) on the melting point of $SrF_2$ was determined using differential thermal analysis. The lowest melting point observed in the system containing $SrF_2$, $ZrF_4$ and impurity fluorides found in WESF $^{90}SrF_2$ was 851 ± 5°C. Two reports on potential applications of isotopes were prepared, and theoretical work continued on the effect of source geometry on the radiation efficiency of $^{137}CsCl$ capsules. (LCL)

**12184** (BNWL-1845-17) PACIFIC NORTHWEST LABORATORY MONTHLY REPORT TO ADVANCED NUCLEAR ENERGY SYSTEMS, SPACE AND SPECIAL PURPOSES DIVISION, FOR OCTOBER 1975. Fullam, H. T. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. 8p. Dep. NTIS $4.00.

At Hanford, strontium will be separated from the high-level waste, then converted to the fluoride, and doubly encapsulated in small, high-integrity containers for subsequent long-term storage. The fluoride conversion, encapsulation and storage will take place in the Waste Encapsulation and Storage Facilities (WESF). This encapsulated strontium fluoride represents an economical source of $^{90}Sr$ if the WESF capsule can be licensed for heat source applications under anticipated use conditions. The objectives of this program are to obtain the data needed to license $^{90}SrF_2$ heat sources and specifically the WESF $^{90}SrF_2$ capsules. The information needed for licensing can be divided into three general areas: long-term $SrF_2$ compatibility data; chemical and physical property data on $^{90}SrF_2$; and capsule property data such as external corrosion resistance, crush strength, etc. The current program is designed to provide the required information. (auth)

**12185** (DPST-75-128-10) $^{238}Pu$ FUEL FORM PROCESSES. Savannah River Laboratory Monthly Report. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). Oct 1975. Contract AT(07-2)-1. 51p. Dep. NTIS $4.50.

Characterization studies of HB-Line production $^{238}PuO_2$ have shown that (1) mode size can now be predicted to within 0.5 mu m (the empirical equation relating processing parameters to particle size was refined and is currently based on 19 laboratory precipitations) and (2) the HB-Line can generally control the mode size of $^{238}PuO_2$ within 0.5 mu m. In studies of alternative precipitation techniques, the following items were observed: (1) increasing the precipitation temperature increases the particle size and decreases agglomeration, (2) the type of agglomeration formed during precipitation is a function of the initial supersaturation (at low supersaturation, rosettes are formed; at high supersaturation, loose agglomerates are formed; and at intermediate levels of supersaturation, spherulites are formed), and (3) two alternative techniques, Pu(IV) reverse strike and Pu(III) reverse strike at high plutonium concentrations, show promise for producing powders that may be hot pressed directly into fuel forms. Pellets hot pressed from LASL shards show that increasing the pressure from 3000 to 5000 psi during hot pressing has a greater effect on pellet density than does decreasing the shard heat-treatment temperature from 1150 to 1050°C. The thermal conductivity of theoretically dense $^{238}PuO_2$ was calculated, and conductivities for $^{238}PuO_2$ powders and shards in air, argon, and helium were measured. (auth)

**12186** USE OF "β-S" ISOTOPIC THERMOELECTRIC GENERATOR IN ANTARCTIC TO ENSURE ENERGY FOR AN AUTOMATIC MAGNETIC VARIATION STATION OF LONG-TERM RECORDING (AMVS-DR). Blinov, A. M.; Korotkov, N. P.; Maysuradze, P. A.; Ragozinskii, A. I.; Sapelkin, B. P.; Kharin, E. P.; Shabarin, A. A. Radiats. Tekh.; No. 9, 115-118(1973). (In Russian)

During a test in 1969 of the first AMVS-DR at the antarctic station "Vostok" [East], the isotopic thermoelectric generator "β-S" was used as a source of electrical and thermal energy. The certificate data of the generator are: heating power, 200 W; electrical power, 10 W with filling by xenon; voltage, 6 V with a 4-ohm load. For safety of transportation the generator was filled with argon, which reduced its power to 6.5 W. A change of the temperature of the outside air considerably affects the power and voltage delivered by the generator. Thus the "β-S" generator No. 1 changes the power by more than 17% during a change of the temperature from +50 to −46°C. Consequently, subsequent AMVS-DP were provided with isotopic sources located in a housing with thermostabilizing devices which guarantee a specific constant temperature. (Ref. Zh.)

**12187** 9TH WORLD ENERGY CONFERENCE, DETROIT, MICHIGAN, SEPTEMBER 22–27, 1974. Preprints. Division 3: Energy Resource Recovery. London; World Energy Conference (1974). vp. (In English and French). (CONF-740910–P3).

Thirty papers were presented at the conference and included in Division 3. A separate abstract was prepared for two papers for NSA. The remaining papers have been included in the Energy Data Base. (RCK)

*For abstracts of individual papers see: 11999 and 12188.*

**12188** ROLE OF NUCLEAR ENERGY IN THE EXPLOITATION OF THE DEEP OCEAN. Devin, B.; Boutaine, J. L.; Galaud, G.; Alleau, T.; Schwartz, J. P.; Mabile, M. Paper 3.1-8, 22p. of 9th World Energy Conference. London; World Energy Conference (1974). (In French)

From 9th world energy conference; Detroit, Michigan, USA (22 Sep 1974). See CONF-740910–P3.

In the next few decades there will be a substantial increase in both number and intensity of deep-sea industrial operations. The unique character of this environment indicates the need for special adaptations of the primary electrical energy sources that will be used. The most probable application is for deep-sea oil fields, beyond the continental shelf, where water depth and distance from shore prevent the extension of existing techniques. Small submersibles, needed for transportation and repairs for these facilities, face similar power supply problems. In these fields, and probably for all kinds of deep-sea operations (habitat, ore recovery, etc.), nuclear energy possesses the inherent qualities of reliability, long life, and autonomy through the entire power range. These characteristics are essential for economic deep-sea operations. Concepts and system projects within four power ranges are presented: very low (under 1 KW)—covered by direct-conversion isotope generators (thermoelectric); low (1 KW to 10 KW)—covered by isotope thermodynamic systems; medium (10 KW to 1 MW)—covered by direct-conversion nuclear reactors (thermionics); and upper (above 1 MW)—covered by the low-scale PWR system. Economic evaluation of these systems is given, and the costs are analyzed. (auth)

# Radiation Sources

## Design and Fabrication

**12189** IRRADIATION CIRCUIT. Gavar, V. V.; Dindun, A. S.; Kramer, M. M.; Platatsis, E. Ya.; Mikelson, A. E.; Tomson, E. Ya. (to AN Latvijskoj SSR, Riga. Inst. Fiziki). French Patent 2,221,793/A/. 13 Mar 1973. 9p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The irradiation loop is provided with a mixing chamber and an additional pump. The mixing chamber is connected at its top with the outputs of the activity generator and the irradiator and at its bottom through the pumps with the inputs of the activity generator and the irradiator. The chamber is arranged in such a fashion that its upper part is much lower than the lower parts of the activity generator and the irradiator. The device is applicable to radiation sources in scientific research or in industrial irradiation processes. (tr-FR)

**12190** FLEXIBLE KILOCURIE COBALT-60 FACILITY FOR MULTI-PURPOSE IRRADIATION APPLICATIONS. Kerr, D. S. M.; Sellschop, J. P. F.; Keddy, R. J.; Nam, T. L. (Univ. of Witwatersrand, Johannesburg). Int. J. Appl. Radiat. Isot.; 26: No. 9, 533-542(Sep 1975).

The design of a shielded holder large enough to contain an activity of up to $3 \times 10^5$ Ci of $^{60}Co$ is described. It incorporates the unusual feature of allowing the source to be moved to positions outside the shield. The safety features incorporated in the design are presented and examples of the use of the "bomb" for atomic excitation and nuclear resonance scattering studies, and for applications such as the sterilization of human bones and tissues are given. (auth)

**12191** PREPARATION AND NEUTRON EMISSION OF $^{241}Am$–Be AND $^{241}Cm$–Be ALLOYS. Buijs, K.; Toussaint, J. C.; Bottini, G. (Commission of the European Communities, Karlsruhe, Ger.). Int. J. Appl. Radiat. Isot.; 26: No. 9, 564-567(Sep 1975).

Preparation procedures and conditions of $^{241}Am$-Be alloys with low Be/Am ratio have been studied. Specific neutron emission yields of these alloys as a function of the Be/Am atomic ratio are considered. The preparation of a $^{244}Cm$-Be alloy with low beryllium content by the same procedures is reported. Both the $^{241}Am$/Be and the $^{244}Cm$/Be alloys with potentially high neutron yields per unit volume (Be/Am ratio lower than 20) show specific neutron yields which are lower than calculated. There are indications that this reduction in neutron yields is due to inhomogeneities. (UK)

## Industrial Uses

*Refer also to abstracts 12157, 12254, and 12671.*

**12192** (INR-1462/16/C,I/B) THE PROGRAM FOR NORMALIZATION OF PRIMARY RESULTS OF STIMULUS-RESPONSE METHOD FLOW INVESTIGATIONS. Craczyk, J.; Wrede, A. (Institute of Nuclear Research, Warsaw (Poland)). 1973. 29p. (In Polish). INIS.

The standard methods of analysis of the results of radioisotope investigations of fluid flows in chemical reactors is proposed. The routine for DTH-GIER is given, which calculates the residence—time distribution functions, evaluates their statistical characteristics and parameters of the simple mathematical flow models. The examples of the routine application are presented. (auth)

**12193** (JAERI-M-5943) DESIGN OF AN EXPERIMENTAL APPARATUS FOR RADIATION-POLYMERIZATION ETHYLENE UNDER HIGH TEMPERATURE AND PRESSURE. Watanabe, H.; Machi, S. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 37p. (In Japanese). INIS.

The radiation-induced polymerization of ethylene under high pressure and temperature is of industrial interest because of the economic and product quality aspects. A research program has been formulated and the apparatus designed to further study the process. The apparatus is designed for the polymerization at a pressure up to 2,000 kg/cm$^2$, a temperature up to 200°C and the dose-rates of $5 \times 10^4$ to $3 \times 10^5$ rad/hr, to produce 30 g of polyethylene per batch. Emphasis in the design is placed on safety, removal of reaction heat, temperature and pressure control, and operational simplicity. The batch polymerization apparatus at a constant pressure with a tubular reactor of 100 ml is found to be suitable for the intended purpose; the data equivalent to those in the flow system are obtainable by moving a radiation source along the tubular reactor. (auth)

**12194** METHOD AND DEVICE FOR MEASURING TIGHTNESS LEAKS IN ROTATIVE ENGINES. (to Commissariat a l'Energie Atomique). French Patent 2,217,684/A/. 14 Feb 1973. 15p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to the measurement of tightness leak as carried out during rotative machine power and wear control. According to the method, a radioactive tracer is injected into a working chamber of the engine between the end of the intake stroke and the compression stroke maximum, then the radioactive activity of each of the working chambers is measured in the exhaust pipe. The invention applies to rotative piston machines such as engines compressors and pumps, as well as to aircraft reaction engines, gas turbines and fast chemical reactors. (FR)

**12195** 20 YEARS OF RADIONUCLIDE MANAGEMENT AND PRODUCTION IN THE CSSR. Hokr, J. (Ustav pro Vyzkum, Vyrobu a Vyuziti Radioisotopu, Prague (Czechoslovakia)). Jad. Energ.; 20: No. 10, 331-333(Oct 1974). (In Czech).

Data are presented on the applications of radionuclides in Czechoslovakia during the past 20 years. The activities of Czechoslovak suppliers of isotope products are outlined, and some statistical data are given on the production and distribution of and foreign trade with radioisotope products. (auth)

**12196** PROSPECTS OF IONIZING RADIATION AND RADIONUCLIDE APPLICATIONS IN CZECHOSLOVAKIA. Vagner, J. (Ceskoslovenska Komise pro Atomovou Energii, Prague). Jad. Energ.; 20: No. 10, 326-330(Oct 1974). (In Czech).

The standard is assessed reached by Czechoslovakia so far in the development of radionuclide methods, and the future trend is indicated of their further development and applications. Information is presented on the results achieved in the cooperation and specialization in nuclear instrument production within CMEA countries. (INIS)

# LIFE SCIENCES

12197 (N-75-23149) RADIATION AND PROTECTION. Margulis, U. Ya. Apr 1975. Translation of Radiatsiya i Zachchita, Atomizdat, Moscow, 1974. (NASA-TT-F-16209). 174p. NTIS $6.25.

Described are the interaction of ionizing radiation with matter, the action of radiation on living organisms, and the protective measures necessary in working with radioactive materials and with sources of ionizing radiation. Information regarding atomic structure and nature of the interaction of radiation with matter are presented. (auth)

## Radiation Effects on Biochemicals

*Refer also to abstracts 12222, 12234, 12260, 12262, 12263, 12265–12273, 12276–12279, 12281, 12288–12291, 12293, 12296, 12302, and 12418.*

12198 (KURRI-TR-120, pp 28-30) REACTION OF RADICAL AND DNA. Hatano, H. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

Ion and radical caused from biomolecules by high energy of radiation secondarily reacted to other stable molecules as well as excited molecules, and caused the chain reaction of radical. This reaction which seemed to be important findings in order to demonstrate the mechanism in the radiation effect upon the living body, was studied from the reaction of radical and DNA. Phenazine methosulfate cation had strong bacterial antagonism to E. coli from the reaction of phenazine cation and nucleic acid. This was because this radical attacked DNA of bacteria, and the ultrastructure disappeared by mixture of SR spectrum phenazine methosulfate shows and DNA. In addition, the bound constant was decided by reaction of radical of polycycle compound and DNA. Similar bound to DNA was evident from the reaction of proflavine and acridine radical. These compounds were broken by adding polymer of lysine and alanine. (JA)

12199 (KURRI-TR-120, pp 31-34) REACTIVITY OF OH RADICALS TO ENZYME PROTEINS IN AQUEOUS SOLUTION. Masuda, T.; Nakano, S.; Kondo, M. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

For the purpose of clarifying the detailed process of devitalization of enzymes by radiation, an analysis of reaction velocity was done only in the occasion of initial reactions of OH radicals with enzyme proteins. The rate constants for the reactions of OH radicals with various substrates were determined by treating competitive reactions using p-nitrosodimethylaniline (PNDA) as a standard substance. The rate constants for the reactions of OH radicals with amino acids were also determined, of which effectiveness was ascertained by comparing those values with the results obtained by other methods. For irradiation, $^{137}Cs$ radiation source (radiation dose: $1.92 \times 10^{16} eVg^{-1}min^{-1}$) was employed, and $1.25 \times 10^{10} M^{-1}sec^{-1}$ was used as the rate constant for the reaction of OH radicals with PNDA. A significant correlation was obtained with amino acids. The values of lysozyme was almost the same as Adams and his co-workers had previously reported. When summing up the correction value to the reactivity which is calculated on the basis of the stereo-structure of protein molecule revealed by x-ray analysis and the rate constant of amino acids to OH radicals, the rate constant of OH radicals to protein itself can be obtained. The calculation of cytochrome c and lysozyme based on this hypothesis resulted in values of $4.46 \times 10^{10}$ $M^{-1}sec^{-1}$ and $4.71 \times 10^{10}$ $M^{-1}sec^{-1}$, and showed a good correlation with the observed values. It was suggested that the reactivity of OH radicals to proteins can be accounted for by the Summation rule based on this hypothesis. (JA)

12200 (KURRI-TR-120, pp 35-38) PULSE RADIOLYSIS OF BIOLOGICALLY ACTIVE SUBSTANCES. Approach to Studies on Electron Transmission in the Living Body. Seki, H. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

The absorption spectra of short-life intermediate of electron presenting in a living body, was examined by pulse radiolysis method, and the transmitting process of electron was studied. In order to study the cation transmission, benzonitrile solutions containing biphenyl and chlorophyll A were irradiated by electron pulse, and the absorption spectra obtained revealed the existence of chlorophyll A cations transmitted from the solvent through biphenyl. Concerning the anion transmission, the absorption spectra of pulse-irradiated THF solutions containing chlorophyll A revealed chlorophyll A anions. In addition, the fact that the coexistence with vitamin A, phenazinemethosulphate, and flavin mononucleotide remarkably reduced the life of chlorophyll A indicated that electrons rapidly transmitted from chlorophyll A anions to these substances. The comparison with difference spectra of p700 which was the principal substances of the photosynthesis in the chloroplast suggested that chlorophyll A cations and anions were produced in the photosynthetic procedure. The absorption spectra and electron transmission of half reducing substance, NAD, were also discussed in this paper. Adams' opinion about the molecular mechanism in the cell sensitization to radioactive irradiation explained by electron transmission, Armstrong's opinion about the molecular mechanism of protecting action of cells to radioactive irradiation explained by hydrogen atom transmission, were represented. (JA)

12201 (KURRI-TR-120, pp 39-44) RADIATION-INDUCED BINDINGS OF VITAL SUBSTANCES. Yamamoto, O. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

As a part of radiochemistry of vital substances, a study of radiation-induced bindings of protein and nucleic acid substances in aqueous solution was made. First of all, it was shown experimentally that OH and $e^-_{aq}$ originated from water are neither concerned with formation of thiyl radical from cysteine and cystine nor phenoxy-radical from aromatic amino acids which contain hydroxy, while it was shown that OH is concerned with formation both of thiyl radical from methionine and aromatic ring radical from aromatic amino acids. The relationship between radiation-induced binding yields and gamma-radiation doses for specific amino acids and bases with serum albumin was illustrated. The rate constant for the formation of aromatic amino acids which had been given by Scholes and his co-workers was referred and the rate constant for binding reaction was discussed. The relationship between radiation doses and the binding yields of various compounds such as tryptophan, nicotinic acids, and maleic acids with DNA, RNA, or serum albumin were shown respectively. The effect of concentration of NaCl on the binding yields was also examined. (JA)

12202 (KURRI-TR-120, pp 55-56) COMPARISON OF DNA DAMAGE PRODUCED BY VARIOUS SOURCES. Tanooka, H. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

Damages produced by various sources such as ultraviolet rays (uv), nitrogen mustard, ionizing radiation, DNase I, 4-hydroxyaminoquinoline I-oxide (4HAQO), and sonication nitrous mustard were classified. Moreover, the possibility of the reconstruction was pointed out. In order to examine the DNA damages, competing ability with marker DNA in transformation of Bacillus subtilis was determined. Then, the intake of transforming DNA labeled with radioisotope and the competing ability were determined. In the uv group, transforming ability was lost, but competing ability was preserved. This indicated that uv gives little effects on the integrity of the DNA particle, although it inactivates DNA genes. In mechanical shearing group, competing ability was inactivated corresponding to the inactivation of transforming ability. This seemed to be due to double-strand breaks. In electron irradiation group, transforming ability and competing ability showed the same degree of decrease. This seemed to be due to interstrand cross link as well as double-strand breaks. The damages by other sources were shown between the above-mentioned groups. (JA)

**12203** (KURRI-TR-120, pp 57-61) EFFECTS OF IRRADIATION ON WATER SOLUTION OF RNASE A. Rokushika, M. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

The water solution of ribonuclease (RNase) A (E.C.2.7.7.16) of the pancreas of cattle was irradiated with $^{60}Co$ $\gamma$-ray and the effects were examined in the following items: the effects on appearance of enzymic activity; the dissociation constant in activity; the effects on amino-acid composition; the effects on compounds of higher order; heterogeneity of enzymic elements; protective activity by inhibitor. Based on these experiments, mechanisms of inactivation of RNase in water solution by irradiation were presumed as follows: Such amino acid residues constituting enzymes as basic amino acid, tyrosyl and sulfurated amino acid residues are decorated with radicals produced from water by irradiation. This decreases the isoelectric point of protein, and hydrogen bonds in molecules are destroyed producing localized structural changes. Since the changes occur with irradiation of relatively small doses, most molecules maintain enzymic activities. However, in active molecules which degenerate reversibly by heat, the structures near the activity center are rather loose. On the other hand, the examination on the rotatory power shows that the whole molecular structure is not severely damaged. The fact that various kinds of parameter of the reaction to parenchyma does not change with $\gamma$-ray irradiation seems to indicate that catalytic functions of enzymes in active molecules are fully maintained in native conditions in spite of partial damages. However, it is presumed that the catalytic activity is lost in the manner of all or none, when such large radiation damages as to change the parameters are given. (JA)

**12204** (KURRI-TR-120, pp 62-64) INHIBITION OF SUBSTRATE OBSTRUCTION IN LACTIC DEHYDROGENASE (LDH) IRRADIATED BY GAMMA RAYS. Saito, M. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

The effects of $\gamma$ rays upon lactic dehydrogenase (LDH) in pig heart were discussed from the point of LDH activity and substrate obstruction activity. The LDH activity was obtained by the decrease of absorption at 340 m$\mu$ accompanied by oxidation of NADH when pyruvic acid and NADH were regarded as substrates. The dose to effect curve upon 0.4 $\mu$g/ml of solution in pig heart was logarithmically decreased by the low concentration of pyruvic acid. However, initially it was increased with the increase of irradiation doses under the excessive concentration of pyruvic acid. In addition, when irradiated LDH was incubated with NAD and pyruvic acid, the increase in absorption at 323 m$\mu$ was decreased, compared with nonirradiated LDH. This suggested that the formation of inactivate complex, i.e. pyruvic acid-NAD-LDH, was inhibited by irradiation. The dissociation of substrate obstruction into dimeride could not be measured so long as it was performed by thin layer gel filtration method. The inhibition of substrate obstruction by irradiation occurred as the previous process of aggregation caused by irradiation. If the experiment in vitro showed the same results as these above results, irradiated LDH could change pyruvic acid into lactic acid and could promote the reoxidation into NAD of anaerobic NADH. (JA)

**12205** PHOTOCHEMISTRY OF THE PHOTODYNAMIC COMPOUNDS. I. Photolysis of Aqueous Solutions of Sulphanilamide. Pawlaczyk, J.; Turowska, W. Acta Pol. Pharm.; 31: 65-70(1974). (In Polish)

Aqueous solutions of sulphanilamide were irradiated with monochromatic UV light emitted by Philips TUV 30 W lamp ($\lambda_{max}$ = 254 nm). During irradiation, the solutions grew dark and a black-brown precipitate formed. The course of photolysis was followed by assaying the irradiated solutions by gas and thin-layer chromatography. There were found 19 decomposition products. Thin-layer chromatograms were developed with a mixture of chloroform and methanol (8:2), and the spots were visualized with the Urk's reagent. (auth)

**12206** EFFECT OF MALATHION AND RADIATION SEPARATELY AND JOINTLY UPON RAT ENZYMES IN VIVO. Gupta, P. K.; Dhar, U.; Bawa, S. R. (Panjab Univ., Chandigarh, India). Environ. Physiol. Biochem.; 5: 49-53(1975).

The effect of malathion (50 mg/kg) and radiation (900 R) separately and jointly upon phosphatases and succinic dehydrogenase has been studied in female albino rats. Malathion and radiation when given separately, at the dose levels used in this study, appear to have no effect on acid and alkaline phosphatase of kidney, heart, and brain. In preirradiated rats given malathion a significant decrease in phosphatases was observed in kidney and brain tissue after as little as 2 h and the values persisted for up to 24 h. No significant change was observed in heart tissue. At the dose level of 50 mg/kg of malathion, no significant change in succinic dehydrogenase was observed; however, radiation caused a significant increase in succinic dehydrogenase of brain and kidney tissue. In preirradiated rats given malathion the effect appeared to be enhanced in time to a certain degree. One could therefore speculate that simple non-specific stress caused by malathion adds to a similar effect of radiation by reducing phosphatases and enhancing the succinic dehydrogenase enzyme. (DA)

**12207** STUDY OF DAMAGE TO DNA IN VITRO UNDER THE ACTION OF IONIZING RADIATIONS. Teoule, R. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. de Radiobiologie). Bull. Inf. Sci. Tech. (Paris); No. 203, 5-10(May 1975). (In French)

Recent results obtained in the identification of the chemical modifications of DNA and its constituents under the action of $\gamma$ rays are described. The radiolysis products provided by the thymine component which were split off from the sugar-phosphate backbone of DNA have been characterized and measured. A new hydrolysis method has enabled to analyze the products provided by the thymine com onent which were attached to the DNA polymer. These results are of interest in the field of radiation-induced mutagenesis and cell repair. (FR)

**12208** MOLECULAR MECHANISMS FOR REPAIR OF DNA. Part A. DNA Repair Process Conference, Squaw Valley, California, February 25-March 1, 1974. Hanawalt, P. C.; Setlow, R. B. (eds.). Basic Life Sciences, Volume 5A. New York; Plenum Press (1975). 460p. (CONF-740231-PA).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

Separate abstracts were prepared for thirty-four papers presented at the conference. An additional 23 papers were presented on various aspects of DNA repair. (HLW)

*For abstracts of individual papers see: 12209–12212, 12260–12287, 12522, and 12523.*

**12209** REPAIRABLE DAMAGE IN DNA: OVERVIEW. Cerutti, P. A. (Univ. of Florida, Gainesville). pp 3-12 of Molecular Mechanisms for Repair of DNA, Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The following structural classes of DNA base damage are discussed: monofunctional lesions causing negligible helix distortion; monofunctional lesions causing minor helix distortion, and lesions causing major helix distortion. Lesions causing minor helix distortion are described under the following headings: products with only slightly altered base-pairing and base-stacking properties; and ring-fragmentation, and ring-elimination products. Lesions causing major helix distortion are described under the following headings: monofunctional lesions with bulky substituents or substantially altered base-pairing properties; intercalation damage; and difunctional lesions. (HLW)

**12210** FORMATION OF DIMERS IN ULTRAVIOLET-IRRADIATED DNA. Brunk, C. (Univ. of California, Los Angeles). pp 61-65 of Molecular Mechanisms for Repair of DNA, Part A. Henawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Evidence has been obtained that in uv-irradiated native DNA, pyrimidine dimers are preferentially formed in long pyrimidine tracts. This effect is not the result of the existence of more dimerizable thymine in the long pyrimidine tracts. The preferential formation of dimers in long pyrimidine tracts is enhanced as the dose of irradiation is decreased. These results suggest that the formation of dimers in native DNA occurs by a cooperative mechanism. Quite likely, dimers are formed only in regions of native DNA that are locally denatured (breathing), in which the bases can be aligned. The formation of a dimer in such a breathing region would tend to lock it open and could lead to cooperative formation of dimers in such regions. If this mechanism for the cooperative formation of dimers is operative then it should be restricted to double-stranded DNA. The pyrimidine tracts of irradiated single-stranded DNA all show virtually the same dimer content, irrespective of the length of the tract. These results are consistent with the hypothesis that dimers form cooperatively in breathing regions. (auth)

**12211** PHOTOREPAIR OF RNA. Gordon, M. P. (Univ. of Washington, Seattle). pp 115-121 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Studies on repair mechanisms operative on RNA are reviewed. Some topics discussed are: photoreactivation of uv-killed TMV RNA by Xanthi plants; relationship between photoinduced lesions and photoreactivation; radioinduced pyrimidine hydrates and pyrimidine cyclobutane dimers in RNA; and relationship between pyrimidine dimers and infectivity of uv-irradiated potato virus X. (HLW)

**12212** BEGINNING OF AN INVESTIGATION OF THE ROLE OF recF IN THE PATHWAYS OF METABOLISM OF ULTRAVIOLET-IRRADIATED DNA IN ESCHERICHIA COLI. Rothman, R. H.; Kato, T.; Clark, A. J. (Univ. of California, Berkeley). pp 283-291 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Evidence is summarized that the Rec F pathway engages in the repair of uv-damaged DNA even in the presence of exonuclease I and supplements the Rec BC pathways of repair previously hypothesized. A diagram is presented to show relationships among the several recognized pathways of repair of uv damage. (HLW)

**12213** MOLECULAR MECHANISMS FOR REPAIR OF DNA. Part B. DNA Repair Processes Conference, Squaw Valley, California, February 25-March 1, 1974. Hanawalt, P. C.; Setlow, R. B. (eds.). Basic Life Sciences, Volume 5B. New York; Plenum Press (1975). 437p. (CONF-740231-PB).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974).

Separate abstracts were prepared for 52 papers presented at the conference. An additional 13 papers were presented on various aspects of DNA repair. (HLW)

*For abstracts of individual papers see: 12214–12217, 12227–12251, 12288–12308, 12331, and 12332.*

**12214** RADIATION-INDUCED STRAND BREAKAGE IN DNA. Ward, J. F. (Univ. of California, Los Angeles). pp 471-472 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Simple model systems were used to characterize the nature of radioinduced DNA strand breaks. Using DNA labeled with [$^3$H] thymidine, it was shown that three monomeric thymine-derived products are released from DNA by irradiation. All three increase with time after irradiation. It was concluded that two post-irradiation time-dependent processes occur in macromolecular DNA: the yield of actual strand breaks increases by a factor of 2; and the chemical nature of the strand break terminus changes, i.e., the yield of monomeric bases continues to increase after the strand break yield has reached a maximum. (HLW)

**12215** INHIBITION OF DNA SYNTHESIS BY ULTRAVIOLET LIGHT. Edenberg, H. J. (Stanford Univ., CA). pp 631-633 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

A model in which uv inhibition of DNA synthesis is due to a halt or pause when the growing point reaches a dimer seems consistent with present data. Ultraviolet irradiation is known to inhibit semiconservative DNA synthesis in mammalian cells, although the mechanism for this inhibition is not known. Models can be grouped into two classes: The inhibition is due to a decrease in the rate of polymerization all along the DNA. The inhibition is due to a halt or pause when the growing point reaches a discrete block to further progress. (auth)

**12216** THYMINE DIMER EXCISION BY EXTRACTS OF HUMAN CELLS. Duncan, J.; Slor, H.; Cook, K.; Friedberg, E. C. (Stanford Univ., CA). pp 643-649 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

An enzyme activity capable of excising thymine dimers in vitro from uv-irradiated, specifically incised DNA was identified in extracts of human cells. Experimental results indicate that extracts of human cells grown in tissue culture contain both uv endonuclease and dimer-excision activities. Tables are presented to show effects of uv radiation and effects of freezing cells on thymine dimer excision in cell-free extracts. (HLW)

**12217** CURRENT KNOWLEDGE OF THE FORMATION AND REPAIR OF DNA DOUBLE-STRAND BREAKS. Hutchinson, F. (Yale Univ., New Haven). pp 699-702 of Molecular Mechanisms for repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The types of double-strand breaks in DNA are described, and information on the number produced by x-rays and on the repair of such breaks is summarized. From the current concepts of molecular biology, it is difficult to see how DNA with random double-strand breaks could be replicated. Thus the repair of these breaks is of the greatest importance for the survival of the ability of a cell to self-duplicate, and perhaps for other cell functions. (auth)

**12218** NONRANDOM DISTRIBUTION OF DAMAGES TO THE DNA STRUCTURE IN THE CASE OF GAMMA IRRADIATION IN VITRO. Todorov, I. N.; Shugalii, A. V.; Fonarev, A. B. (Inst. of Molecular Biology and Genetics, Kiev). Dokl. Biochem.; 220: No. 1-6, 87-89(1975).

Translated from Dokl. Akad. Nauk SSR; 220: No. 5, 1226-1229 (1975).

The purpose of this work was to investigate the nature of the distribution of defects of the primary and second structure in γ-irradiated fractions of a heterogeneous preparation of thymus DNA, differing both in the average GC composition (blocks) and in the content of repetitive sequences (repetitions), which makes it possible to relate the interpretation of the distribution of damages in γ-irradiated DNA both to differences in the radiosensitivity of the bases and to the peculiarities of their distribution (pyrimidine isopleths) among fractions of DNA. It has been shown that the block arrangement of pyrimidine nucleotides (pyrimidine isopleths) in fractions of different nucleotide compositions, isolated from animal DNA, is different, that is, in the AT fraction the degree of block arrangement of pyrimidines is substantially greater than in the GC fraction and total DNA. If we proceed from the fact that in our experiments the degree of damage to the DNA fractions drops with increasing enrichment of the preparation with CG-rich fragments, as well as from the data on the increased radiosensitivity of the pyrimidine bases, we should assume that the nonrandom nature of the distribution of damages to the primary and secondary structure with respect to DNA fractions is due primarily to peculiarities of their block arrangement with respect to pyrimidine bases, i.e., peculiarities of the organization of the primary structure of DNA. This assertion is all the more probable in that a statistically significant correlation has been detected between the relative content of pyrimidine blocks in the DNA of organisms and their radiosensitivity. (ERB)

**12219** INFLUENCE OF HEAVY WATER ($D_2O$) ON THE STABILITY OF PROCOLLAGEN TO THERMAL DENATURATION AND TO THE ACTION OF COLLAGENASE. Aleksandrov, V. Ya.; Vitvitskii, V. P.; Levdikova, G. A. (Botanical Inst., Leningrad). Dokl. Biochem.; 220: No. 1-6, 90-92(1975).

Translated from Dokl. Akad. Nauk SSR; 220: No. 6, 1445-1448 (1975).

The stability of procollagen (tropocollagen), dissolved in $D_2O$ and $H_2O$, to the denaturing action of heating and the proteolytic action of collagenase was compared. It was found that the thermal denaturation of procollagen, dissolved in heavy water, began at a higher temperature than in the case of $H_2O$. A comparative investigation of the rates of enzymatic cleavage of procollagen showed that procollagen dissolved in $D_2O$ is hydrolyzed more slowly than in $H_2O$. (ERB)

**12220** INFLUENCE OF ULTRAVIOLET LIGHT ON THE CATALYTIC PROPERTIES OF THE MEMBRANE $Ca^{2+}$-ATPase FROM HUMAN ERYTHROCYTES. Volotovskii, I. D.; Vol'f, G.; Doze, K. (Inst. of Photobiology, Minsk). Dokl. Biochem.; 220: No. 1-6, 93-96(1975).

Translated from Dokl. Akad. Nauk SSR; 220: No. 6, 1449-1452 (1975).

The influence of uv light on the catalytic properties of $Ca^{2+}$-ATPase, an enzyme firmly associated with the erythrocyte membrane, was studied. It was found that the photosensitivity of the enzyme was dependent on the structural state of the entire membrane. (ERB)

**12221** ESR STUDIES OF RADIATION DAMAGE IN NUCLEIC ACIDS, BASES, NUCLEOSIDES, AND NUCLEOTIDES. Wyard, S. J.; Elliott, J. P. (Guy's Hospital, London). Ann. N.Y. Acad. Sci.; 222: 628-639(Dec 1973).

Results of electron spin resonance studies of radiation damage in nucleic acids, bases, nucleosides, and nucleotides are presented. Studies were conducted on single crystals, at room temperature

and at 77°K, frozen solutions, and liquid solutions. Radical species in irradiated DNA are discussed. (ERB)

## Radiation Effects on Cells

*Refer also to abstracts 12213, 12255, 12260, 12305, 12307, 12308, and 12375.*

**12222** (CONF-750571-1) MOLECULAR DOSIMETRY OF CHEMICAL MUTAGENS: MEASUREMENT OF MOLECULAR DOSE AND DNA REPAIR GERM CELLS. Sega, G. A. (Oak Ridge National Lab., Tenn. (USA)). 1975. 21p. Dep. NTIS $4.50.

From 6th annual meeting of the environmental Mutagen Society; Miami Beach, Florida, USA (9 May 1975).

Molecular dosimetry in the germ cells of male mice is reviewed with regard to in vivo alkylation of sperm heads, in vivo alkylation of sperm DNA, and possible alkylation of sperm protamine. DNA repair in male germ cells is reviewed with regard to basic design of experiments, DNA repair in various stages of spermatogenesis, effect of protamine on DNA repair following treatment with EMS or x radiation, and induction of DNA repair by methyl methanesulfonate, propyl methanesulfonate, and isopropyl methanesulfonate. (HLW)

**12223** (KURRI-TR-120, pp 67-68) CHROMOSOME INJURY BY RADIATION AND ITS REPARATION. Terashima, T. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

New collecting method of DNA was developed, and we tried to quantify chromosome x-rays injury. L cells in mice were resolved with 2% sodium lauryl sulfate (SDS) on sucrose gradients, and isolated DNA (SDS-DNA) was collected. Physical and chemical properties of SDS-DNA were discussed. Tritiated-thymidine was labelled and autoradiography was done in order to demonstrate threads of DNA strands 150 to 300 $\mu$ in diameter. In addition, HeLa cells which were previously labelled with $^3$H-thymidine were resolved with 0.05% SDS, and were treated with NaCl. The properties of DNA (NaCl-DNA) obtained by this way were stated. HeLa cells which were previously labelled were irradiated with x rays (60kVp). In addition, NaCl-DNA was isolated and the number of double-strand breaks was studied. Frequencies of breaks were linearly enlarged with the increase of doses, and it was found to occur as a single event. 1.4 breaks occurred in a HeLa cell per 1 rad. When $D_0$ value in this cell was regarded as 135 rads, 200 breaks on the average occurred in a cell, and then 37% of cells ($e^{-1}$) having this injury survived and proliferated. It took longer time for double-strand breaks to repair compared with single-strand breaks. During the process of study on NaCl-DNA, DNA bound structure producing accessary peak in addition to main peak of DNA profile was found. This structure was sensitive to x-rays, compared with double-strand DNA. In addition, its injury was bound to DNA. Therefore, this suggested that the complex structure of DNA was disturbed, i.e. possibility to combine the chromosome aberration.

**12224** NUCLEAR AND CYTOPLASMIC PROTEIN SYNTHESIS IN TWO STRAINS OF L5178Y CELLS OF DIFFERENT RADIOSENSITIVITIES. Szumiel, I.; Rosiek, O.; Budzicka, E. (Inst. of Nuclear Research, Warsaw). Stud. Biophys.; 51: No. 3, 193-200(22 Sep 1975).

The cellular response to irradiation manifests itself, among others, by disturbances in the biosynthesis of important macromolecules. In irradiated non-proliferating cell systems, where no DNA synthesis occurs, the protein synthesis remains unaltered or even radiation-induced stimulation is observed; in proliferating cells, which—according to the Bergonié-Tribondeau law—are more radiosensitive than non-proliferating cells, DNA synthesis is inhibited by radiation and so is the synthesis of nuclear proteins. The relationship of these disturbances to radiosensitivity of proliferating cells, however, remains obscure. In this work two cellular systems proliferating in vitro were used. They differ in radiosensitivities by a factor of ca 2. For these systems incorporation was compared of $^{14}$C-amino acids into nuclear and cytoplasmic protein fractions as well as of $^3$H-thymidine into DNA after irradiation with 400 rads of x rays. (auth)

**12225** INFLUENCE OF CAFFEINE ON THE DNA SYNTHESIS AND THE SEDIMENTATION BEHAVIOR OF NORMAL AND IRRADIATED MAMMALIAN CELLS. Schroeder, E.; Magdon, E. (Central Inst. for Cancer Research, Berlin). Stud. Biophys.; 51: No. 3, 209-214(22 Sep 1975).

The influence of caffeine on DNA sedimentation from normal and $^{60}$Co $\gamma$-irradiated HeLa-cells (10 kR) has been investigated. In a concentration range from $10^{-3}$ to $10^{-2}$ M, caffeine does neither cause a shift of the DNA gradient profile from untreated cells nor any delay in the rejoining of single-strand breaks. The incorporation of thymidine-$^3$H in HeLa and lymphoma cells is not inhibited by caffeine at a concentration of $5 \cdot 10^{-3}$ M for 3 hours. However, with the same concentration, caffeine lowers the inhibition of thymidine-$^3$H incorporation after 5 kR $^{60}$Co $\gamma$ irradiation in the two cell types studied. (auth)

**12226** POSTREPLICATION GAP FILLING IN THE DNA OF X-RAY DAMAGED CHINESE HAMSTER CELLS. Koerner, I.; Malz, W. (Central Inst. of Molecular Biology, Berlin). Stud. Biophys.; 51: No. 2, 115-126(15 Sep 1975).

In x-irradiated Chinese hamster cells the newly synthesized DNA has a lower molecular weight than the DNA in control cells. This reduced molecular weight has been interpreted by gap induction opposite the lesions in the parental DNA strands. Within two hours these postreplication gaps were closed. With the aid of BrdUrd-photolyse-technique it could be demonstrated that the gaps were filled by de novo synthesis. But we were not able to show a participation of parental DNA in the gap-filling process. (auth)

**12227** ABSENCE OF A PYRIMIDINE DIMER REPAIR MECHANISM FOR MITOCHONDRIAL DNA IN MOUSE AND HUMAN CELLS. Clayton, D. A.; Doda, J. N.; Friedberg, E. C. (Stanford Univ. School of Medicine, CA). pp 589-591 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

We have assayed the ability of mammalian cells to remove pyrimidine dimers from their mitochondrial DNA. The results indicate that pyrimidine dimers are not required for as long as 48 hr after uv irradiation. Furthermore, molecules containing pyrimidine dimers are unable to replicate and are simply diluted out in subsequent cell divisions. (auth)

**12228** REPAIR IN MAMMALIAN CELLS: OVERVIEW. Painter, R. B. (Univ. of California, San Francisco). pp 595-600 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Studies on DNA repair in mammalian cells are reviewed. Some topics discussed are: repair of uv and x-irradiated parental DNA; importance of dimers and postreplication repair; role of recombinational events in postreplication repair; and analysis of DNA size by sucrose gradients. (HLW)

**12229** REPAIR (OR RECOVERY) EFFECTS IN QUIESCENT CHINESE HAMSTER CELLS: AN ATTEMPT AT CLASSIFICATION. Hahn, G. M. (Stanford Univ. School of Medicine, CA). pp 601-605 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Increased survival of density-inhibited Chinese hamster cells after a variety of treatments is analyzed in terms of half-time of repair magnitude of repair, and dependence upon nutrient medium during the repair interval. At least three different systems are identified: x-ray-like, uv-like, and an entirely different system after heat shock. Repair after methyl methanesulfonate and after visible light (in bromodeoxyuridine-substituted cells) may be interpreted as a superposition of the x-ray and uv-like repair systems. (auth)

**12230** POSTREPLICATION REPAIR OF DNA IN UV-IRRADIATED MAMMALIAN CELLS. Lehmann, A. R. (Univ. of Sussex, Brighton, Eng.). pp 617-623 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Some current controversies concerning the mechanism of postreplication repair in mammalian cells are discussed. We have found that two xeroderma pigmentosum cell lines normal in excision-repair are abnormal in postreplication repair. The rate of postreplication repair is slower than that in normal cells and is caffeine sensitive. In normal human fibroblasts, caffeine has little effect. (auth)

**12231** SYNTHESIS BY UV-IRRADIATED HUMAN CELLS OF NORMAL-SIZED DNA AT LONG TIMES AFTER IRRADIATION. Buhl, S. N.; Setlow, R. B.; Regan, J. D. (Univ. of Tennessee, Oak Ridge). pp 625-626 of Molecular Mechanisms for Repair of

DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Although the DNA synthesized in human cells within the first hour after irradiation is in smaller segments than in unirradiated cells, the segments made at long times after irradiation are of normal size even though there has been no dimer excision. (auth)

**12232** EFFECTS OF CAFFEINE ON POSTREPLICATION REPAIR IN XERODERMA PIGMENTOSUM CELLS. Buhl, S. N.; Regan, J. D. (Univ. of Tennessee, Oak Ridge). pp 627-630 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Compared to its effects on unirradiated cells, caffeine inhibited DNA chain elongation and joining in uv-irradiated xeroderma pigmentosum (XP) cells but not in irradiated normal human cells. The drug also inhibited the ability of XP cells to recover and make DNA of normal size at long times after irradiation. (auth)

**12233** POSTREPLICATION REPAIR IN HUMAN CELLS: ON THE PRESENCE OF GAPS OPPOSITE DIMERS AND RECOMBINATION. Meneghini, R.; Hanawalt, P. C. (Stanford Univ., CA). pp 639-642 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Human cells prelabeled with [$^{32}$P] phosphate were exposed to uv and then pulse-labeled with [$^{3}$H] thymidine. The DNA from these cells was subsequently treated with T4 endonuclease V, an enzyme which specifically nicks DNA at positions adjacent to pyrimidine dimers. Sedimentation in alkaline sucrose gradients revealed that both the DNA made before and that made after irradiation contained nuclease-sensitive sites, indicating that a recombinational process between these DNAs might be occurring during postirradiation incubation. Sedimentation in neutral sucrose gradients showed that the molecular weight of native DNA remained unchanged for both DNAs upon endonuclease treatment, indicating that gaps opposite dimers are not necessarily formed after irradiation. (auth)

**12234** STUDIES ON DNA REPAIR IN MAMMALIAN CELLS: AN ENDONUCLEASE WHICH RECOGNIZES LESIONS IN DNA. Bacchetti, S. (State Univ. of Leiden, Rijswijk, Netherlands). pp 651-654 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

An endonuclease recognizing lesions in uv- and gamma-irradiated or depurinated DNA has been detected in human cell extracts and partially purified from calf thymus. Some of its properties and its possible role in DNA repair are discussed. (auth)

**12235** FORMATION AND REJOINING OF DNA STRAND BREAKS IN X (gamma)-IRRADIATED CELLS IN RELATION TO THE STRUCTURE OF MAMMALIAN CHROMATIC. Lett, J. T. (Harvard Medical School, Boston). pp 655-664 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Mammalian cells usually possess the capacity to rejoin disruptions introduced into their deoxynucleoprotein structures by ionizing radiation. I believe that analyses of the strand-break-inducing and the strand-break-rejoining mechanisms operating on the DNA of irradiated cells can provide clues to the nature of the structure of mammalian chromatin in situ. In particular, I wish to consider evidence relevant to the idea that mammalian DNA contains special sites which are sensitive to radiation, alkali, and perhaps other agents and treatments. This concept is usually referred to as the subunit hypothesis. The present communication extends previous arguments along similar lines with an evaluation of more recent data. Since these data have been, or will be, published in the open literature or elsewhere in this book, they will be described here only in general terms. (auth)

**12236** CHO CELL REPAIR OF SINGLE-STRAND AND DOUBLE-STRAND DNA BREAKS INDUCED BY gamma- AND alpha-RADIATIONS. Cole, A.; Shonka, F.; Corry, P.; Cooper, W. G. (Anderson Hospital and Tumor Inst., Houston, TX). pp 665-676 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Neutral and alkaline sucrose gradient sedimentation analysis was used to measure double- and single-strand breaks in the DNA of Chinese hamster ovary (CHO) cells exposed to either gamma- or alpha-radiation. After irradiation, cells were incubated for 15–180 min to test the ability of the cell to rejoin the DNA breaks. Essentially complete rejoining was observed for single-strand breaks induced by gamma- or alpha-doses below 20 krad and for double-strand breaks induced by gamma doses below 60 krad. Approximately 80 percent rejoining was observed for double-strand breaks induced by alpha doses below 40 krad. At higher doses, the repair system appeared to saturate in such a way that essentially no additional breaks were rejoined. (auth)

**12237** REPAIR OF DNA DOUBLE-STRAND BREAKS IN MAMMALIAN CELLS AND THE ORGANIZATION OF THE DNA IN THEIR CHROMOSOMES. Lange, C. S. (Univ. of Rochester School of Medicine and Dentistry, NY). pp 677-683 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The molecular weight of native DNA has been accurately determined by the use of a semiautomated sucrose gradient system. A monodisperse size distribution (speed dependence free) of eighth-of-a-chromatid pieces [1.7 x $10^{10}$ daltons, with 95 percent confidence (fiducial) limits of +-48 percent] was found. This size has been confirmed by viscoelastometry. Ionizing radiation rapidly breaks each of these pieces into about 21 subunits (again monodisperse) of 8 x $10^{8}$ daltons each. With increasing dose (greater than 2 krad) the subunits are themselves randomly broken down into even smaller pieces. Postirradiation incubation at 37$^{0}$C permits the cells to repair both DNA double-strand breaks and intersubunit linkages at the same dose-independent rate ($T_{37}$) of about 55 min, the same rate as found in Micrococcus radiodurans. The repair data are compatible with a first-order-kinetics repair system, analogous to the post-UV excision-repair system, which becomes saturated at high doses (greater than 60 krad). Specially constructed enzyme gradients show that the linkages contain at least two protein molecules each covalently bound to the end of a subunit and linking the subunits together by a disulfide bond(s). Correlation of cell survival and DNA break kinetics yields two possible models. These are that the two-thirds of the lethal events which are due to improperly or unrepaired double-strand breaks result from either a misrepair frequency of 3.5 x $10^{-3}$ (rather high for a mutation frequency) or the induction of a double-strand break in a single eighth-of-a-chromatid unit which is essential for survival but which cannot be repaired, possibly because the unit contains the double-strand break repair system gene(s). (auth)

**12238** KINETICS OF THE SINGLE-STRAND REPAIR MECHANISM IN MAMMALIAN CELLS. Dugle, D. L.; Gillespie, C. J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). pp 685-687 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Alkaline sucrose gradient measurements of single-strand breaks from sublethal x-ray doses yield the same breakage efficiency as from lethal doses. Repair of the breaks is random, first order with a single rate constant, and characterized by 24 kcal/mole activation energy. (auth)

**12239** DAMAGE-REPAIR STUDIES OF THE DNA FROM X-IRRADIATED CHINESE HAMSTER CELLS. Elkind, M. M. (Argonne National Lab., IL). pp 689-698 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Sedimentation studies of the DNA-containing material released from Chinese hamster cells lysed on top of an alkaline sucrose gradient have shown these principal points: after short lysis periods (e.g., approximately 60 min, approximately 25$^{0}$C), the DNA label from unirradiated cells sediments as a two-peaked pattern; the relative positions of these peaks are strongly dependent on centrifugal force; with increasing lysis time, DNA lost from one peak (the complex, the peak containing lipid) appears in the other (the main peak). The same transition is effected, for a given lysis time, if prior to lysis cells are x-irradiated with small doses (from 100 to 700 rads). Since such doses are in the high survival range (approximately 80 percent to approximately 3 percent, respectively), an association between damage to the complex and survival is suggested. And the cosedimentation of lipid and DNA in the complex is lost after doses that resolve the complex into main-peak DNA, while post-irradiation incubation for repair results in a re-formation of the complex plus cosedimentation of lipid and DNA once again. (auth)

**12240** RELATIONSHIP AMONG REPAIR, CANCER, AND GENETIC DEFICIENCY: OVERVIEW. Selow, R. B. (Oak Ridge National Lab., TN). pp 711-717 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The papers in this section document the following points: many different types of damage to DNA may be repaired; a number of completely different types of damage to DNA may be repaired; chemical and physical carcinogens damage DNA, as indicated by direct observation and by the fact that they provoke the sequence of repair steps in DNA; and the use of xeroderma pigmentosum cells, the analogue of excision-deficient bacterial cells, emphasizes the utility of investigating the effects of chemical carcinogens on human cells. Three large problems remain. The first is the biochemical nature of the complementation process among the various XP groups. The second is the nature of the physical or chemical damage to DNA that results in neoplastic transformation. To date, this is easily approachable only for uv irradiation. The third is the detailed molecular mechanisms by which changes in DNA appear as neoplastic transformation. (auth)

**12241** DIRECT EVIDENCE THAT PYRIMIDINE DIMERS IN DNA RESULT IN NEOPLASTIC TRANSFORMATION. Hart, R. W.; Setlow, R. B. (Oak Ridge National Lab., TN). pp 719-724 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

A specific test for the biological role of UV-induced pyrimidine dimers in DNA is photoreactivation (PR). Fish contain large amounts of the PR enzyme. Portions of cell suspensions of tissue from various organs of the fish Poecilia formosa were exposed to uv radiation (254 nm), then injected into isogenic recipients. An incident fluence of 20 $J/m^2$ resulted in 10 percent of the fish with large granulomas and 100 percent with thyroid carcinomas. If the irradiated cell suspension was illuminated with PR light before injection, the yields of both types of lesion were reduced approximately 10-fold. If the PR light was given before the uv exposure, there was no reduction in the numbers of growths. These experiments show that pyrimidine dimers in DNA can lead to neoplastic transformation. (auth)

**12242** GENETIC COMPLEMENTATION ANALYSIS OF XERODERMA PIGMENTOSUM. Bootsma, D.; De Weerd-Kastelein, E. A.; Kleijer, W. J.; Keyzer, W. (Erasmus Univ., Rotterdam). pp 725-728 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

To characterize the mutations in different unrelated xeroderma pigmentosum (XP) patients, a complementation test was performed using the technique of somatic cell hybridization. DNA repair following uv exposure was studied in multinuclear cells resulting from fusions between in vitro cultivated cells from different patients. The parental XP cells performed low or negligible levels of repair DNA synthesis, whereas in some combinations binuclear hybrid cells showed repair DNA synthesis as a result of complementation. The results indicate the presence of five different complementation groups in XP. (auth)

**12243** USE OF ENZYMATIC ASSAY TO EVALUATE UV-INDUCED DNA REPAIR IN HUMAN AND EMBRYONIC CHICK FIBROBLASTS AND MULTINUCLEATE HETEROKARYONS DERIVED FROM BOTH. Paterson, M. C. (Atomic Energy of Canada, Ltd., Chalk River, Ont.); Lohman, P. H. M. pp 735-745 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

A sensitive enzymatic assay has been utilized to monitor repair of uv-induced damage to DNA in primary human and embryonic chick cells in multinucleate heterokaryons artificially derived from both. The assay exploits the unique ability of a purified repair endonuclease to attack uv-irradiated DNA at sites containing pyrimidine dimers. These nuclease-susceptible sites are subsequently observed as single-strand scissions by velocity sedimentation in alkaline sucrose gradients. Incubation of uv-damaged cultures followed by extraction and enzymatic analysis of the radioactively labeled DNA enables one to trace the disappearance of such sites in vivo and hence to monitor endogenous repair activity. When uv-irradiated human cells are incubated in the dark, the curve for site removal exhibits a two-phase exponential decline; i.e., there exists a fast component responsible for elimination of 60 percent of the initial damage and a second one approximately 7 times slower in rate. The removal of sites is not further enhanced by exposing cells to blacklight during post-uv incubation. Conversely, uv-damaged chick cells rid their DNA of all nuclease-susceptible sites rapidly (i.e., at an exponential rate approximately 13 times faster than the fast component of site removal in human cells) when incubated under blacklight but not when kept in the dark. These data indicate the presence in human and embryonic chick cells of distinct enzymatic mechanisms for the elimination of dimer-containing sites. Whereas human fibroblasts rely heavily on a light-independent process, excision-repair, chick fibroblasts possess a light-dependent mechanism, presumably photoenzymatic repair. (auth)

**12244** CYTOTOXIC AND MUTAGENIC EFFECTS OF CARCINOGENIC AROMATIC AMIDES AND POLYCYCLIC HYDROCARBONS AND ULTRAVIOLET IRRADIATION IN NORMALLY REPAIRING AND REPAIR-DEFICIENT (XERODERMA PIGMENTOSUM) DIPLOID HUMAN SKIN FIBROBLASTS. Maher, V. M.; McCormick, J. J. (Michigan Cancer Foundation, Detroit). pp 785-787 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The cloning ability of fibroblasts taken from a xeroderma pigmentosum patient proved 2.5 to 3.5 times more sensitive to the cytotoxic effect of active derivatives of carcinogens or to uv irradiation than that of normal cells. They also exhibited a corresponding 2.5- to 3.5-fold greater increase in the frequency of induced mutations to 8-azaguanine resistance per survivor, which might have been expected since these XP cells exhibit less than 20 percent of the DNA-repairing capacity of the normal cells following exposure to such DNA-damaging agents. (auth)

**12245** REPAIR OF DNA STRAND BREAKS IN PROGERIC FIBROBLASTS AND AGING HUMAN DIPLOID CELLS. Little, J. B.; Epstein, J.; Williams, J. R. (Harvard Univ. School of Public Health, Boston). pp 793-800 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The rate of rejoining of DNA strand breaks induced by 10 krad of gamma-irradiation has been studied in normal human diploid skin fibroblasts and skin fibroblasts from six patients with symptoms of progeria. Although slightly more rapid in very early passage, the repair rate in normal cells was similar throughout most of their life span in vitro. The appearance of cells with reduced repair capacity was evident as the cultures became senescent. The progeric fibroblasts varied greatly in their response to irradiation. The rate of repair was greatly reduced in two strains, whereas in two others extensive DNA degradation was consistently observed in unirradiated cells. Degradation was apparently related to the radiation received from the incorporated radiolabel. Normal repair was seen in progeric fibroblasts transformed by SV40 virus. (auth)

**12246** DNA REPAIR AND LIFE SPAN OF MAMMALS. Hart, R. W.; Setlow, R. B. (Oak Ridge National Lab., TN). pp 801-804 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The ability of fibroblasts to perform unscheduled synthesis (a measure of excision-repair) after uv irradiation was measured autoradiographically for seven mammalian species at several times after uv irradiation. The initial rate and the maximum incorporation of [$^3$H]dThd increased with the life span of the species. (auth)

**12247** INCREASED DNA EXCISION-REPAIR AS PATHOGENESIS OF A HUMAN LEUKEMIA. Huang, A. T. F. (Duke Univ. Medical Center, Durham, NC). pp 805-806 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

At least two possibilities exist which may explain the increasing cell mass in chronic lymphocytic leukemia: CLL cells may have a longer life span than normal cells with identical proliferative capacity or the proliferative capacity may be slightly higher but the difference may be below the limit of detection. The following results suggest that the first possibility is true, in that CLL cells show an increased capacity to repair DNA damage induced by ultraviolet irradiation or x-rays. Compared to normal cells, after irradiation CLL cells incorporate more tritiated thymidine into their DNA, excise pyrimidine dimers (the major uv photo-

product) more rapidly and to a greater extent, and rejoin x-ray-induced strand breaks more rapidly. (auth)

**12248** RADIOSENSITIZATION OF A HUMAN CELL LINE LACKING REPAIR REPLICATION. Lee, Y. C.; Kulhanian, F.; Byfield, J. E. (Univ. of California, Los Angeles). pp 807-811 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

A human cell line has been isolated that is deficient in x-ray-induced repair replication. The slope of the radiation survival curve is greater in the presence of the anthracycline antibiotic, adriamycin. The results suggest that radiosensitization by DNA-binding drugs is more probably related to DNA strand breakage phenomena than to the polymerase step of excision-repair. (auth)

**12249** REPRESSIBLE DNA-REPAIR SYSTEM IN MOUSE NEUROBLASTOMA CELLS. McCombe, P.; Kidson, C. (Univ. of Queensland, Brisbane). pp 813-815 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Differentiated mouse neuroblastoma cells are extremely sensitive to uv light even though they can undergo excision-repair. A postreplication repair system present in proliferating cells is reversibly repressed in differentiated neuroblasts, and its genetic control is not coupled directly with DNA replication. (auth)

**12250** DNA REPAIR AND UV RESISTANCE IN HUMAN MELANOMA. Lavin, M.; Chalmer, A. H.; Kidson, C. (Univ. of Queensland, Brisbane. pp 817-819 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Human melanoma cells are highly resistant to 254-nm light. Resistance appears to depend on their ability to continue replication after high uv doses due to the presence of very efficient postreplication repair system, while excision-repair is of relatively minor importance. (auth)

**12251** FAULTY DNA REPAIR FOLLOWING ULTRAVIOLET IRRADIATION IN FANCONI'S ANEMIA. Poon, P. K.; Parker, J. W.; O'Brien, R. L. (Univ. of Southern California School of Medicine, Los Angeles). pp 821-824 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Fibroblasts from a patient with Fanconi's anemia were deficient in their ability to excise uv-induced pyrimidine dimers from their DNA but were capable of single-strand break production and unscheduled DNA synthesis. (auth)

**12252** MOLEKULYARNAYA RADIOBIOLOGIYA KELTOCHNOGO YADRA. (Molecular Radiobiology of the Cell Nucleus). Kuzin, A. M. Moscow; Atomizdat (1973). 208p.

This book considers the most important physical-chemical processes which occur in nuclei of irradiated cells and which are basic to radiation damage of cells, tissues and organisms. The book generalizes a large amount of literature material, and systematically presents the individual studies of the author. A description is first given of radiation changes taking place in chromosomes, chromatin and the nucleoproteides and proteins of the nucleus in comparison with radiation shifts in cell energetics and its membrane properties and with reactions of low-molecular-weight radiotoxins. A great deal of attention is devoted to repair processes in cell nuclei. (tr-auth)

**12253** CONCERNING THE HETEROGENEITY OF THE LYMPHOCYTE POPULATION (REGULARITIES IN RADIOSENSITIVITY). Shcherbova, E. N.; Gruzdev, G. P. Probl. Gematol. Pereliv. Krovi.; 19: No. 6, 21-25(Jun 1974). (In Russian)

For English translation see the journal Probl. Hematol. Blood Transfus.

The problem of the heterogeneity of the lymphocyte population was studied by comparison of the radiosensitivity of the lymphocytes with their size. During irradiation of the animals with ionizing radiation two groups of lymphocytes were detected, radiosensitive and radiostable. The first group consists of no more than 10% of the total number of lymphocytes in the blood and includes cells with sizes from 25 to 50-60 $\mu^2$. The other group consists of no less than 90% of all the lymphocyte population. Radiation damage to the lymphocytes of a given group is not equally probable. There are very radiosensitive lymphocytes and relatively resistive lymphocytes. It was established that the probability of their radiation death is directly proportional to the area of the lymphocytes and the threshold dose is described by the formula $\ln y = 0.52 \ln x + 0.84$, where y is the area of the lymphocyte and x is the radiation dose. (tr-INIS)

## Radiation Effects on Microorganisms

*Refer also to abstracts 12208, 12211–12213, and 12404.*

**12254** (APIA-T-01) BRAZILIAN PROGRAM FOR FOOD IRRADIATION. Dias Filho, M. (Administracao do Programa de Irradiacao de Alimentos, Rio de Janeiro (Brazil)). 1973. 25p. (In Portuguese). INIS.

Brazil, because of its geographical situation, has some characteristic aspects in relation to foods. For this reason, the Brazilian Food Irradiation Program started its work only with the foods that are the main constituents of the diet of one typical region, and studied the preservation of black beans, rice, corn, wheat, potatoes, and onions, and their derivates. Results such as dose range, other processes in combination, shelf-life, increasing cost of irradiation, legal aspects are now in the final steps or already finished. Other results about toxicity, being long term studies, are delayed; these studies have been finished only with potatoes, and are now starting with rice. The Brazilian possibilities for industrial application of the irradiation process for preservation are good. Currently there is a loss rate of more or less 30%. Private companies have expressed interest in irradiation processes. For these reasons, Brazil can be one of the first countries that will use the peaceful application of nuclear energy in the field of food preservation. (INIS)

**12255** (BNL-20689) DAMAGES TO DNA THAT RESULT IN NEOPLASTIC TRANSFORMATION. Setlow, R. B. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 21p. Dep. NTIS $4.50.

Some topics discussed are: correlation between carcinogens and mutagens; defective DNA repair in uv-damaged xeroderma pigmentosum cells; analysis of nucleotide damage to DNA following exposure to chemicals or radiations; photoreactivation in uv-irradiated Escherichia coli; tumor development in fish; excision repair as an aid in identifying damage; detection of excision repair; role of endonucleases in repair of uv damage; and alkylation products and tumors. (HLW)

**12256** (CONF-751221-(Absts.)) SYMPOSIUM ON MUTAGENICITY, CARCINOGENICITY, AND TERATOGENICITY OF CHEMICALS, BARODA, INDIA, DECEMBER 4 - 6, 1975. Program and Abstracts. (Department of Atomic Energy, Bombay (India). Biology and Medical Committee). 1975. 60p. Department of Atomic Energy, Bombay, India.

Papers presented at the conference were arranged under the following main headings: mutagenicity of chemicals, teratogenicity of chemicals, genetic variability in populations, and repair systems. Studies included effects of the following mutagens: EMS, mitomycin, urethane, cyclophosphamide, x radiation, and $\gamma$ radiation. (HLW)

**12257** SURVIVAL OF B. SUBTILIS SPORES IRRADIATED WITH 1.0, 2.0 OR 4.0 keV ELECTRONS. Barber, D. E.; Moore, R.; Hutchinson, T. (Univ. of Minnesota, Minneapolis). Stud. Biophys.; 51: No. 2, 105-113(15 Sep 1975).

A scanning electron microscope was used to generate beams of electrons of 1.0, 2.0, or 4.0 keV. The beams irradiated layers of B. subtilis spores. As electron energy increased, the radiation penetrated more deeply into the spore. Survival data for the spores demonstrated unequivocally that the core of the spore was substantially more sensitive to radiation than its membrane wall structure. The survival curve was not exponential, which indicated either a multi-step reaction process or dose-rate dependence of the reaction. (auth)

**12258** STUDIES ON SPROUT INHIBITION OF ONIONS BY GAMMA IRRADIATION. I. Influence of Time Interval Between Harvest and Irradiation, Radiation Dose, and Environmental Conditions on Sprouting. Thomas, P.; Srirangarajan, A. N.; Limaye, S. P. (Bahaba Atomic Research Centre, Bombay). Radiat. Bot.; 15: No. 3, 215-222(Sep 1975).

Sprout inhibition of onions by gamma irradiation was found to be influenced by the physiological state of the bulbs at the time of irradiation, radiation dose, and the storage temperature after irradiation. Sprouting was minimal during storage at ambient temperature (26 to 32°C) while exposure to low temperature (4 to 20°C) or widely fluctuating diurnal temperature (20°C min to 30°C max) accelerated it. Six to nine Krad inhibited sprouting during storage under the above conditions only if the bulbs were irradiated within a fortnight of harvest when they were in the dormant state. Twenty-five Krad caused a transient stimulation of sprouting regardless of the time of irradiation

while 6 to 12 Krad only stimulated sprouting when the time interval between harvest and irradiation exceeded three weeks. Irradiation at all dose levels caused discoloration of the growth center, the extent of which was minimal in bulbs exposed to low doses soon after harvest and in those stored at ambient temperature. (auth)

**12259** GAMMA-IRRADIATION OF WET CORN. Microbiological Aspects. Poisson, J.; Cahagnier, B. (Institut National de Recherches Agronomiques (INRA), 75 - Paris (France). Station de Biochimie et Physico-Chimie des Cereales). Ann. Technol. Agric.; 22: No. 4, 757-772(1973). (In French)

From International symposium on preservation of wet harvested grains; Paris, France (5 Mar 1973).

In the course of a survey of several years work on microbiological decontamination and control of wet corn by gamma irradiation the following factors are studied: inhibiting and selective effect of gamma irradiation (100 to 500 krads) on the microflora of grains; evolution of residual microflora of irradiated wet grains (moisture content about 35%), during storage experiments under ventilated or airtight conditions. Two important points emerge from those studies. The microflora which develops on irradiated sample is much less varied than that of the control sample. The microbial population of an irradiated sample rises up in a few days on a level with the initial one of the control, then goes on increasing while remaining, as a rule, slightly inferior to that of the control placed under the same conditions. This greatly lowers the practical interest of irradiation, which can only be used together with another treatment able to inhibit the quick growth of the residual microflora. (FR)

**12260** EXCISION-REPAIR OF GAMMA-RAY DAMAGED THYMINE IN BACTERIAL AND MAMMALIAN SYSTEMS. Hariharan, P. V.; Remsen, J. F.; Cerutti, P. A. (Univ. of Florida, Gainesville). pp 51-59 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The selective excision of products of the 5,6-dihydroxy-dihydrothymine type (t') for gamma-irradiated or $OsO_4$-oxidized DNA or synthetic poly [d(A-T)] was observed with crude extracts of Escherichia coli and isolated nuclei from human carcinoma HeLa S-3 cells and Chinese hamster ovary cells. The results with E. coli extracts allow the following conclusion: The uvrA-gene product is not required for t' excision; radiation-induced strand breakage is not required for product excision; experiments with extracts of E. coli polAexl showed that the 5' yields 3' exonuclease associated with polymerase I is responsible for the removal of t'; experiments with extracts of E. coli endo I lig 4 and the ligase inhibitor nicotinamide mononucleotide showed that polynucleotide ligase accomplishes the last strand resealing step in the excision-repair of t'. Isolated nuclei from HeLa and Chinese hamster ovary cells possess the necessary enzymes for the selective excision of t' from gamma-irradiated or osmium tetroxide oxidized DNA. Approximately 25 to 35 percent of the products were removed from DNA within 60 min. Unspecific DNA degradation was very low. Radiation-induced strand breakage is not required for product removal. (auth)

**12261** DARK REPAIR IN BACTERIOPHAGE SYSTEMS: OVERVIEW. Friedberg, E. C. (Stanford Univ., CA). pp 125-133 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA Repair Processes Conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Studies on dark repair of DNA in bacteriophages T4 and lambda are reviewed. Some topics discussed are: uv sensitivity of phage mutants; effects of endonuclease on uv-irradiated phage DNA; pyrimidine dimers as substrate sites for endonuclease in DNA; electron microscopic studies of enzyme-treated uv-irradiated DNA; role of phage T4 genes in DNA repair; and host-cell reactivation, prophage reactivation, and uv reactivation in phase lambda. (HLW)

**12262** ENZYMIC MECHANISM OF EXCISION-REPAIR IN T4-INFECTED CELLS. Sekiguchi, M.; Shimizu, K.; Sato, K.; Yasuda, S.; Ohshima, S. (Kyushu Univ., Fukuoka). pp 135-142 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA Repair Processes Conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Excision of pyrimidine dimers from ultraviolet-irradiated DNA in a cell-free system of Escherichia coli infected with bacteriophage T4 consists of two different steps, one to induce a single-strand break at a point close to a pyrimidine dimer and the other to release dimer-containing nucleotide from the DNA. The enzymes responsible for these steps were isolated and the reactions were characterized; T4 endonuclease V introduces a break at the 5' side of a dimer and 5' yields 3' exonucleases, which are also induced by T4, act at the break to excise dimer-containing nucleotides. We isolated temperature-dependent nu mutants, which exhibit increased sensitivity to uv at 42°C but not at 30°C, and found that the mutants induce temperature-sensitive T4 endonuclease V, indicating that the nu gene of T4 is indeed the structural gene for T4 endonuclease V and that the enzyme is responsible for the first step of excision-repair. A possible mechanism of excision-repair in T4-infected cells is discussed. (auth)

**12263** REPAIR OF ULTRAVIOLET DAMAGE BY PHAGE T4: THE ROLE OF THE EARLY PHAGE GENES. Symonds, N. (Univ. of Sussex, Brighton, Eng.). pp 143-147 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Studies on the role of early T4 genes in the repair of uv damage in phage T4 are reviewed. Some topics discussed are: comparison between uv sensitivity of phage particles and uv sensitivity of bacteria; functional survival of phage T4 early genes; role of early genes in multiplicity reactivation of phage T4; kinetics of DNA synthesis and phage production; and genetic recombination between damaged parental genomes. (HLW)

**12264** RECOVERY OF PHAGE LAMBDA FROM ULTRAVIOLET DAMAGE. Devoret, R.; Blanco, M.; George, J.; Radman, M. (CNRS, Gif-sur-Yvette, France). pp 155-171 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Recovery of phage lambda from ultraviolet damage can occur, in the dark, through three types of repair processes as defined by microbiological tests: host-cell reactivation, prophage reactivation, and uv reactivation. This paper reviews the properties of the three repair processes, analyzes their dependence on the functioning of bacterial and phage genes, and discusses their relationship. Progress in the understanding of the molecular mechanisms underlying the three repair processes has been relatively slow, particularly for uv reactivation. It has been shown that host-cell reactivation is due to pyrimidine dimer excision and that prophage reactivation is due to genetic recombination (prereplicative). We provide evidence showing that neither of these mechanisms accounts for uv reactivation of phage lambda. Furthermore, uv reactivation differs from the other repair processes in that it is inducible and error-prone. Whether uv-damaged bacterial DNA is subject to a similar repair process is still an open question. (auth)

**12265** ESCHERICHIA COLI UV ENDONUCLEASE (CORRENDONUCLEASE II). Braun, A.; Hopper, P.; Grossman, L. (Brandeis Univ., Waltham, MA). pp 183-190 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

An endonuclease from Escherichia coli which acts specifically upon uv-irradiated DNA (correndonuclease II) and is absent from the uvrA and uvrB mutants has been isolated and partially characterized. The enzyme is present in normal amounts in the uvrC mutant. It elutes from phosphocellulose at about 0.25 M potassium phosphate (pH 7.5) and passes through dialysis tubing. The enzyme binds tightly to ur-irradiated DNA but does not bind to unirradiated DNA. The enzyme incises irradiated DNA to the 5' side of a pyrimidine dimer and leaves a 5'-phosphoryl terminus which can be resealed with polynucleotide ligase. The K/sub m/ of the enzyme is about $1.5 \times 10^{-8}$ M dimers. Endonucleolytic activity of the enzyme is inhibited by caffeine with a K/sub I/ of about 10mM. (auth)

**12266** ENDONUCLEASE II OF ESCHERICHIA COLI. Goldthwait, D. A.; Kirtikar, D.; Hadi, S. M.; Friedberg, E. C. (Case Western Reserve Univ., Cleveland). pp 191-196 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Endonuclease II has been purified from Escherichia coli and characterized. The enzyme degrades both alkylated and depurinated DNA, as well as gamma-irradiated DNA. It also has been shown to attack DNA containing $O^6$-methylguanine following treatment of the DNA with the carcinogen methylnitrosurea. (auth)

**12267** ENDONUCLEASE III: AN ENDONUCLEASE FROM ESCHERICHIA COLI THAT INTRODUCES SINGLE POLYNUCLEOTIDE CHAIN SCISSIONS IN ULTRAVIOLET-IRRADIATED DNA. Radman, M. (Harvard Univ., Cambridge, MA). pp 197-200 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA Repair Processes Conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

An endonuclease that makes single polynucleotide chain scissions in uv-irradiated DNA has been purified from Escherichia coli. The activity has the following properties: (1) unirradiated DNA is attacked very little if at all; single-stranded DNA is not attacked, whether irradiated or not; there is no requirement for divalent cations, and the activity is not affected by the addition of EDTA; the pH optimum is approximately 7; the activity is inhibited by 1 M NaCl, single-stranded DNA, transfer RNA, and unirradiated double-stranded DNA; the sedimentation coefficient, $S_{20}$,/sub W/, is approximately 2.6; it is a basic protein. The enzyme is tentatively named E. coli endonuclease III. The physiological function of the endonuclease has not yet been established. (auth)

**12268** ESCHERICHIA COLI ENDONUCLEASE WHICH ACTS ON X-IRRADIATED DNA. Strniste, G. G.; Wallace, S. S. (City Univ. of New York, Bronx). pp 201-204 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

An endonuclease activity which acts on x-irradiated DNA has been found in extracts of Escherichia coli. For every single-strand break induced directly in the DNA by x rays, there exists approximately one additional x-ray damage sensitive to this endonuclease. Similar activities have been demonstrated in E. coli B/r and B/sub s-1/, which differ in their repair capabilities. (auth)

**12269** SUBSTRATE SPECIFICITY OF MICROCOCCUS LUTEUS UV ENDONUCLEASE AND ITS OVERLAP WITH DNA PHOTOLYASE ACTIVITY. Patrick, M. H. (Univ. of Texas, Dallas). pp 205-208 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The action of an endonuclease from Micrococcus luteus that operates on uv damage in DNA overlaps with that of DNA photolyase from yeast: homo- and heterocyclobutane dipyrimidines in DNA are substrates for both enzymes, but pyrimidine adducts or the spore photoproduct in DNA are not. As expected from this overlap, the action of the two enzymes is mutually interfering: single-strand nicks introduced by the endonuclease effectively preclude photoreactivation; conversely, formation of a photolyase-cyclobutane dipyrimidine complex can prevent nicking by the endonuclease. (auth)

**12270** ROLE OF DNA POLYMERASE I IN EXCISION-REPAIR. Glickman, B. W. (Leiden State Univ.). pp 213-218 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The ability of three different DNA polymerase I mutants of Escherichia coli to carry out excision-repair was examined. Strains having the same genetic origin but carrying either the polA1, polA107, resA1, or $pol^+$ alleles were compared. The rate of ultraviolet-induced dimer excision was slightly reduced, relative to that found in $Pol^+$ strains, in the PolA1 strain; greatly reduced in the PolA107 strain; and found not to occur in the ResA1 strain. Ultraviolet-light-induced repair synthesis as determined by the ultraviolet-stimulated incorporation of $^3$H-labeled 5-bromo-2'-deoxyuridine into DNA of the parental density showed that the polA1 mutation resulted in an increase in repair replication, while the presence of the polA107 allele caused a reduction in the amount of repair synthesis relative to that of the $Pol^+$ strain. The ResA1 strain, however, showed no ultraviolet stimulation of the incorporation of the density label. These observations indicate that DNA polymerase I plays a key role in the excision-repair process in E. coli. (auth)

**12271** INVOLVEMENT OF ESCHERICHIA COLI DNA POLYMERASE-I-ASSOCIATED 5' yields 3' EXONUCLEASE IN EXCISION-REPAIR OF UV-DAMAGED DNA. Heyneker, H. (Leiden State Univ.); Klenow, H. pp 219-223 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

From comparative studies between Escherichia coli PolA107 cells (lacking 5' yields 3' exonucleolytic activity associated with DNA polymerase I) and the isogenic wild-type strain, and between the purified DNA polymerase I preparations isolated from these strains, it can be concluded that the 5' yields 3' exonuclease is involved in excision of pyrimidine dimers in E. coli. Evidence is presented that the polA107 mutation is located on that part of the DNA polymerase I gene coding for the small fragment on which 5' yields 3' exonucleolytic activity is found. (auth)

**12272** ENZYMATIC REPAIR OF UV-IRRADIATED DNA IN VITRO. Hamilton, L. D.; Mahler, I.; Grossman, L. (Brandeis Univ., Waltham, MA). pp 235-243 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Excision repair of uv-damaged Bacillus subtilis transforming DNA has been carried out by a sequential enzyme system in vitro. Incision adjacent to the pyrimidine dimer in the DNA strand by correndonuclease II-initiated excision of the damage by the 5' yields 3'-directed exonuclease of the Micrococcus luteus DNA polymerase. Reinsertion of nucleotides into the gap in the strand by the DNA polymerase at $10^0$C terminated in a single-strand break which was sealed by a polynucleotide ligase, thereby repairing the DNA strand. This restored biological activity to damaged DNA up to doses resulting in 60 percent inactivation of transforming activity. At higher doses, less repair was achieved, due to the development of double-strand breaks during the in vitro incision and excision steps. (auth)

**12273** REPAIR REPLICATION IN PERMEABILIZED ESCHERICHIA COLI. Masker, W. E.; Simon, T. J.; Hanawalt, P. C. (Stanford Univ., CA). pp 245-254 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

We have examined the modes of DNA synthesis in Escherichia coli strains made permeable to nucleoside triphosphates by treatment with toluene. In this quasi in vitro system, polymerase-I-deficient mutants exhibit a nonconservative mode of synthesis with properties expected for the resynthesis step of excision-repair. This uv-stimulated DNA synthesis can be performed by either DNA polymerase II or III and it also requires the uvrA gene product. It requires the four deoxynucleoside triphosphates; but, in contrast to the semiconservative mode, the ATP requirement can be partially satisfied by other nucleoside triphosphates. The ATP-dependent recBC nuclease is not involved. The observed uv-stimulated mode of DNA synthesis may be part of an alternate excision-repair mechanism which supplements or complements DNA-polymerase-I-dependent repair in vivo. (auth)

**12274** REPAIR BY GENETIC RECOMBINATION IN BACTERIA: OVERVIEW. Howard-Flanders, P. (Yale Univ. School of Medicine, New Haven). pp 265-274 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

DNA molecules that have been damaged in both strands at the same level are not subject to repair by excision but instead can be repaired through recombination with homologous molecules. Examples of two-strand damage include postreplication gaps opposite pyrimidine dimers, two-strand breaks produced by x-rays, and chemically induced interstrand cross-links. In ultraviolet-irradiated bacteria, and newly synthesized DNA is of length equal to the interdimer spacing. With continued incubation, this low-molecular-weight DNA is joined into high-molecular-weight chains (post-replication repair), a process associated with sister exchanges in bacteria. Recombination is initiated by pyrimidine dimers opposite postreplication gaps and by interstrand cross-links that have been cut by excision enzymes. The free ends at the resulting gaps presumably initiate the exchanges. Postreplication repair in Escherichia coli occurs in $recB^-$ and $recC^-$ but is greatly slowed in $recF^-$ mutants. RecB and recC are the structural genes for exonuclease V, which digests two-stranded DNA by releasing oligonucleotides first from one strand and then from the other. The postreplication sister exchanges in ultraviolet-irradiated bacteria result in the distribution of pyrimidine dimers between parental and daughter strands, indicating that long exchanges involving both strands of each duplex occur. The R1 restriction endonuclease from E. coli has been used to cut the DNA of a bacterial drug-resistance transfer factor with one nuclease-sensitive site, and also DNA from the frog Xenopus enriched for ribosomal 18S and 28S genes. The fragments were annealed with the cut plasmid DNA and ligated, producing a new larger plasmid carrying the eukaryotic rDNA and able to infect and replicate in E. coli. (auth)

**12275** RECOMBINATION AND POSTREPLICATION REPAIR. Rupp, W. D.; Levine, A. D.; Trgovcevic, Z. (Yale Univ. School of Medicine, New Haven). pp 307-312 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The available data concerning postreplication repair are summarized. In Escherichia coli, recombination is implicated in this repair because the recA$^+$ gene is necessary and because strand exchanges occur that extend over long regions. Other experiments involving phage-induced resistance also point to an interrelation between recombination and repair. In this phenomenon, gene products of lambda bacteriophage are introduced into bacteria, resulting in an increased resistance of the cells when they are subsequently exposed to x rays. (auth)

**12276** ULTRAVIOLET-LIGHT-INDUCED INCORPORATION OF BROMODEOXYURIDINE INTO PARENTAL DNA OF AN EXCISION-DEFECTIVE MUTANT OF ESCHERICHIA COLI. Ley, R. D. (Argonne National Lab., IL). pp 313-316 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Bromodeoxyuridine-containing regions approximately $1.5 \times 10^4$ nucleotides in length, and at intervals equivalent to the pyrimidine dimer content of the DNA, have been observed in the parental DNA of an excision-defective strain of Escherichia coli exposed to 10 ergs mm$^{-2}$ at 254-nm followed by prolonged incubation in the presence of bromodeoxyuridine. (auth)

**12277** DISTRIBUTION OF PYRIMIDINE DIMERS DURING POSTREPLICATION REPAIR IN UV-IRRADIATED EXCISION-DEFICIENT CELLS OF ESCHERICHIA COLI K12. Ganesan, A. (Stanford Univ., CA). pp 317-320 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

During postreplication repair in excision-deficient mutants of Escherichia coli K-12, pyrimidine dimers are gradually lost from uv-irradiated DNA. Our data indicate that dimers are transferred, by a process which may involve genetic exchange, into daughter strands made after irradiation. Dimer transfer appears to continue through several rounds of replication, resulting in the gradual dilution of dimers into successive generations of DNA molecules. (auth)

**12278** EXPERIMENTS ON THE FILLING OF DAUGHTER-STRAND GAPS DURING POSTREPLICATION REPAIR. Bridges, B. A.; Sedgwick, S. G. (Univ. of Sussex, Brighton, Eng.). pp 321-324 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

When Escherichia coli deficient in excision-repair replicate their DNA after uv irradiation, the newly synthesized strands contain gaps, presumed to be opposite pyrimidine dimers, which are rejoined during subsequent incubation, by a process believed to be recombinational in nature. The detailed mechanism of postreplication repair is, however, far from clear. We have attempted to answer two somewhat different questions: whether or not the daughter-strand gap persists because of the continued presence of the dimer on the opposite strand, and which if any of the three DNA polymerases are required for filling of daughter-strand gaps. (auth)

**12279** POSTREPLICATION REPAIR GAP FILLING IN AN ESCHERICHIA COLI STRAIN DEFICIENT IN dnaB GENE PRODUCT. Johnson, R. C. (Medical Univ. of South Carolina, Charleston). pp 325-329 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Gaps in daughter-strand DNA synthesized after exposure of Escherichia coli E279 to ultraviolet light are filled during reincubation at 30$^0$C for 20 min. Escherichia coli E279 is phenotypically DnaB$^-$ when incubated at 43$^0$C. Cells incubated at 43$^0$C were tested for their ability to complete postreplication repair gap filling. It is concluded that the dnaB gene product is essential for postreplication repair gap filling and that the inhibition seen is not initially the result of degradation. (auth)

**12280** INVOLVEMENT OF uvrD, exrA, AND recB GENES IN THE CONTROL OF THE POSTREPLICATIONAL REPAIR PROCESS. Youngs, D. A.; Van der Schueren, E.; Smith, K. C. (Stanford Univ. School of Medicine, CA). pp 331-333 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Ultraviolet radiation survival studies support the hypothesis that the uvrD, exrA and recB mutations inhibit separate branches of the postreplicational repair process. Results suggest that each of the mutations uvrD, exrA, and recB acts on a branch of the postreplicational repair process which is at least partially independent of those inhibited by the other mutations. Since the uvrB and uvrD exrA recB strain was not as uv sensitive as the uvrB recA strain, at least one additional branch of postreplicational repair, possibly dependent on recF, must be postulated. (auth)

**12281** RELATIONSHIPS AMONG REPAIR, MUTAGENESIS, AND SURVIVAL: OVERVIEW. Witkin, E. M. (Rutgers—The State Univ., New Brunswick, NJ). pp 347-353 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Studies on pathways of survival, mutagenesis, and repair of genetically damaged cells are reviewed. Some topics discussed are: uv-induced mutations in Escherichia coli; role of pyrimidine dimers in repair of DNA strand breaks; recombinational repair of strand breaks; and role of DNA polymerase in repair of uv damage. (HLW)

**12282** THERMAL ENHANCEMENT OF ULTRAVIOLET MUTABILITY IN A dnaB uvrA DERIVATIVE OF ESCHERICHIA COLI B/r: EVIDENCE FOR INDUCIVE ERROR-PRONE REPAIR. Witkin, E. M. (Rutgers—The State Univ., New Brunswick, NJ). pp 369-378 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

DNA damage triggers coordinate expression of a cluster of diverse functions in Escherichia coli, including prophage induction, filamentous growth, and aberrant reinitiation of DNA replication at the chromosomal origin. The SOS repair hypothesis proposes that one of these coordinately inducible functions is an error-prone system of DNA repair (SOS repair) which is responsible for ultraviolet mutagenesis. In dnaB strains, incubation at 42$^0$C stops DNA synthesis and induces lambda prophage and should, therefore, also induce the postulated error-prone repair activity. Thermal posttreatment of a dnaB uvrA derivative of E. coli B/r is found to enhance the yield of ultraviolet-light-induced mutations as much as 50-fold, while having no such effect in the dnaB$^+$ parent strain. The results support the SOS repair hypothesis. The possibility is discussed that the inducible repair system is a mutagenic DNA polymerase. (auth)

**12283** lexB: A NEW GENE GOVERNING RADIATION SENSITIVITY AND LYSOGENIC INDUCTION IN ESCHERICHIA COLI K12. Blanco, M.; Levine, A.; Devoret, R. (CNRS, Gif-sur-Yvette, France). pp 379-382 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The following topics are briefly discussed: bacterial mutants resistant to thymine deprivation; sensitivity of Escherichia coli mutants to uv and x radiation; effects of uv radiation on DNA degradation; and host-cell reactivation and prophage-reactivation of phage lambda. (HLW)

**12284** INDIRECT SUPPRESSION OF RADIATION SENSITIVITY OF A recA$^-$ STRAIN OF ESCHERICHIA COLI K12. Mount, D. W.; Walker, A. C.; Kosel, C. (Univ. of Arizona, Tucson). pp 383-388 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

It has been shown previously that the radiation sensitivity of LexA$^-$ strains of Escherichia coli K-12 can be suppressed by thermosensitive mutations (designated tsl) that are closely linked to the lexA locus. These are thought to be intragenic suppressors that reduce the activity of the diffusible product that gives rise to the lexA$^-$ phenotype (Mount et al., 1973). When a recA mutation is crossed into a suppressed tsl$^-$ strain, the extreme radiation sensitivity usually conferred by a recA mutation is considerably reduced without any detectable change in genetic recombination deficiency. Suppression of uv sensitivity depends upon the activity of the uvrA$^+$ product. We propose that at least part of the radiation sensitivity of a recA$^-$ strain is due to a DNA repair defect that is different from inability to perform genetic exchanges and depends upon the presence of the lexA$^+$ product. We hypothesize that the lexA$^+$ product is a repressor of the synthesis of repair enzymes. In recA$^+$ cells with DNA lesions, repressor is inactivated leading to enzyme induction but this does not occur in recA$^-$ cells. tsl mutations inactivate repressor leading to constitutive enzyme synthesis and bypassing the need for recA$^+$ product to inactivate the lexA$^+$ product. (auth)

**12285** TWO-LESION-HYPOTHESIS FOR UV-INDUCED MUTATION IN RELATION TO RECOVERY OF CAPACITY FOR

DNA REPLICATION. Doudney, C. O. (Albert Einstein Medical Center, Philadelphia). pp 389-392 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The two-lesion hypothesis for uv-induced mutation would include the induction of a lesion damaging the active DNA replication site followed by protein and RNA formation leading to restoration of DNA replication. These events in one way or another would lead to induction of the error-prone repair mechanism. The macromolecules involved in induction of the error-prone mechanism could be the initiation protein and RNA or/and other RNA and protein formed at about the same time as the initiation macromolecules. The other lesion necessary for uv-induced mutation would be a pyrimidine dimer within the length of the potentially mutated gene and subject to repair by the error-prone mechanism. The thermal enhancement of uv mutation in the tif strain of E. coli presumably eliminates the necessity for uv-induction of the DNA synthesis-blocking lesion. (auth)

**12286** EFFECT OF GENES CONTROLLING RADIATION SENSITIVITY ON CHEMICAL MUTAGENESIS IN YEAST. Prakash, L. (Univ. of Rochester, NY). pp 393-395 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

Ultraviolet radiation, x radiation, nitrogen mustard, methyl methanesulfonate, and dimethyl sulfate were found to revert all the tester strains with the same efficiency or without any dependence on simple types of base-pair changes, and it was concluded that these mutagens were nonspecific in the types of base-pair changes produced. The cycl-131 tester was used in studies designed to determine the genetic control of mutation induction using a variety of mutagens. The rad 6 and rad g genes greatly reduce the frequency of chemically induced reversion of cycl-131. (HLW)

**12287** INFLUENCE OF REPAIR ON THE SPECIFICITY OF ULTRAVIOLET-INDUCED REVERSION OF AN OCHRE ALLELE OF THE STRUCTURAL GENE FOR ISO-1-CYTOCHTOME C. Lawrence, C. W.; Stewart, J. W.; Sherman, F.; Christensen, R. (Univ. of Rochester, NY). pp 397-398 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The specific action of uv on the reversion of the ochre allele cycl-9, in which 21 out of 23 revertants have been shown to arise from A · T-to-G · C transitions at position one in the UAA codon, was found to depend on the function of the RAD6 gene, since cycl-9 reversion occurred by a variety of single-base-pair substitutions in a strain carrying the rad6-1 allele. (auth)

**12288** EFFECT OF MUTATIONS IN lig AND polA ON UV-INDUCED STRAND CUTTING IN A uvrC STRAIN OF ESCHERICHIA COLI. Seeberg, E.; Rupp, W. D. (Yale Univ. School of Medicine, New Haven). pp 439-441 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

In experiments on the kinetics of strand breakage of bacterial DNA in a uvrC mutant, it was shown that the results are similar to those described earlier for the breakage of superinfecting lambda DNA. In the first several minutes after irradiation, more breaks appear in a uvr strain than in the uvrC mutant, but at later times the situation is reversed. The action of the uvrC gene product may be to interfere with the joining by polynucleotide ligase of the break made by the uv endonuclease. (HLW)

**12289** DEPENDENCE UPON GROWTH MEDIUM AND THE polA, polC, recA, recB, recC, AND exrA GENES OF SEPARATE BRANCHES OF THE uvr GENE-DEPENDENT EXCISION-REPAIR PROCESS IN ESCHERICHIA COLI K12 CELLS. Smith, K. C.; Youngs, D. A.; Van der Schueren, E. (Stanford Univ. School of Medicine, CA). pp 443-451 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The repair of single-strand breaks which arise in DNA during the uvr gene-dependent excision-repair process was examined in certain radiation-sensitive strains of Escherichia coli K12. The results suggest that the excision-repair process may be divided into two branches, one which is dependent on the presence of growth medium and also the $rec^+ exr^+$ genotype, and a second which can occur in buffer (growth medium independent) and is largely dependent on DNA polymerase I. DNA polymerase III appears to be involved in the growth-medium-dependent branch of excision repair, and also in the residual growth-medium-independent repair which occurs in polA1 cells. Chloramphenicol, dinitrophenol, and impurities present in some brands of agar all appear to inhibit the growth-medium-dependent branch of excision-repair. The similarities of the two branches of excision-repair to two known pathways for the repair of x-ray-induced DNA chain breaks are discussed. (auth)

**12290** NEAR-UV PHOTOPRODUCT(S) OF L-TRYPTOPHAN: AN INHIBITOR OF MEDIUM-DEPENDENT REPAIR OF X-RAY-INDUCED SINGLE-STRAND BREAKS IN DNA WHICH ALSO INHIBITS REPLICATION-GAP CLOSURE IN ESCHERICHIA COLI DNA. Yoakum, G.; Eisenstark, A.; Webb, R. B. (Argonne National Lab., IL). pp 453-458 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Near-uv photoproducts of L-tryptophan (TP), which are especially toxic for recombination-deficient (rec) mutants, were found to inhibit medium-dependent repair of x-ray-induced single-strand breaks. This inhibitor also slows the rate of closure of replication gaps, suggesting that these two processes may have a common pathway (or share a required step which TP can inhibit). (auth)

**12291** RADIOBIOLOGY OF DNA STRAND BREAKAGE. Johansen, I. (Univ., Oslo). pp 459-469 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The yield of single-strand breaks in lambda DNA within lysogenic host bacteria was measured after exposure to 4-MeV electrons (50 msec) and rapid transfer (45 msec) to alkaline detergent. In nitrogen anoxia the yield was $1.2 \times 10^{-12}$ DNA single-strand breaks per rad per dalton, and under full oxygenation the yield increased to $5 \times 10^{-12}$ breaks per rad per dalton. A search for the presence of fast repair mechanisms failed to demonstrate the presence of any mechanism for repair of strand breaks operating within a fraction of a second. Strand breaks produced in the presence of oxygen were repaired in 30–40 sec, while breaks produced under anoxia were rejoined even slower. A functional product from the polA1 gene was needed for the rejoining of the broken molecules. Intermediate levels of DNA strand breakage seen at low concentrations of oxygen are dependent on the concentration of cellular sulfhydryl compounds, suggesting that in strand breakage oxygen and hydrogen donors compete for reactions with radiation-induced transients in the DNA. Intercomparisons of data on radiation-induced lethality of cells and single-strand breaks in episomal DNA allow the distinction between two classes of radiation-induced radicals, $R_1$ and $R_2$, with different chemical properties; $R_1$ reacts readily with oxygen and N-oxyls under formation of potentially lethal products. The reactivity of oxygen in this reaction is 30–40 times higher than that of TMPN. $R_2$ reacts 16 times more readily than $R_1$ with oxygen under formation of single-strand breaks in the DNA. $R_2$ does not react with N-oxyls. (auth)

**12292** DNA REPAIR IN DNA-POLYMERASE-DEFICIENT MUTANTS OF ESCHERICHIA COLI. Smith, D. W.; Tait, R. C.; Harris, A. L. (Univ. of California, San Diego). pp 473-481 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Escherichia coli mutants deficient in DNA polymerase I, in DNA polymerases I and II, or in DNA polymerase III can efficiently and completely execute excision-repair and postreplication repair of the uv-damaged DNA at $30^0$C and $43^0$C when assayed by alkaline sucrose gradients. Repair by Pol $I^-$ and Pol $I^-$, Pol $II^-$ cells is inhibited by 1-beta-D-arabinofuranosylcytosine (araC) at $43^0$C but not at $30^0$C, whereas that by Pol $III^-$ cells is insensitive to araC at any temperature. Thus, either Pol I or Pol III is required for complete and efficient repair, and in their absence Pol II mediates a limited, incomplete dark repair of uv-damaged DNA. (auth)

**12293** RECOVERY OF THE PRIMING ACTIVITY OF DNA OF X-IRRADIATED ESCHERICHIA COLI. Zhestyanikov, V. D.; Barenfeld, L. S.; Barskaya, T. V. (Inst. of Cytology, Leningrad). pp 497-500 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The template activity of DNA in RNA synthesis in vitro has been studied in Escherichia coli B/r and B/sub s-1/ after exposure to x-rays and postirradiation incubation in growth medium for 60 min at 37°C. The incubation of E. coli B/r after irradiation with 9.3 krad results in the increase of the priming activity of DNA practically to that of unirradiated cells, while after exposure to 18.6 krad the incubation leads to a partial increase in its priming activity. As for E. coli B/sub s-1/, the incubation of the bacteria irradiated with 9.3 krad causes a slight recovery in the priming activity of DNA. (auth)

**12294** REPAIR PROCESSES IN DIVERSE SYSTEMS: OVERVIEW. Hanawalt, P. C. (Stanford Univ., CA). pp 503-506 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Studies on DNA repair in several bacterial systems as well as in eukaryotes are reviewed. Some topics discussed are: excision repair of uv damage in Mycoplasma; repair replication in uv-irradiated Tetrahymena; repair of double-strand breaks in DNA of Micrococcus radiodurans; DNA repair in Neurospora; lack of dimer excision in x-irradiated Vicia faba; and DNA repair in Nicotiana, Haplopappus, and Chlamydomonas. (HLW)

**12295** REPAIR OF DOUBLE-STRAND BREAKS IN MICROCOCCUS RADIODURANS. Burrell, A. D.; Dean, C. J. (Chester Beatty Research Inst., Sutton, Eng.). pp 507-512 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Micrococcus radiodurans has been shown to sustain double-strand breaks in its DNA after exposure to x-radiation. Following sublethal doses of x-rays (200 krad in oxygen or less), the cells were able to repair these breaks, and an intermediate fast-sedimenting DNA component seemed to be involved in the repair process. (auth)

**12296** DNA REPAIR AND ITS RELATION TO RECOMBINATION-DEFICIENT AND OTHER MUTATIONS IN BACILLUS SUBTILIS. Ganesan, A. T. (Stanford Univ. School of Medicine, CA). pp 513-519 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

DNA repair processes operating in Bacillus subtilis are similar to other transformable bacterial systems. Radiation-sensitive, recombination-deficient mutants are blocked in distinct steps leading to recombination. DNA polymerase I is essential for the repair of x-ray-induced damage to DNA but not for recombination. (auth)

**12297** REPAIR OF ULTRAVIOLET DAMAGE IN HAEMOPHILUS INFLUENZAE DNA. Setlow, J. K.; LeClerc, J. E. (Oak Ridge National Lab., TN). pp 521-524 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Excision and postreplication repair in Haemophilus influenzae differ in a number of respects from these well-known repair processes in Escherichia coli. Excision-repair of transforming DNA takes place only after its integration. Like other readily transformable bacteria, Haemophilus influenzae does not contain any photoreactivating enzyme. UV damage in this microorganism is repaired by an excision mechanism and by postreplication repair. (auth)

**12298** DNA REPAIR AND THE GENETIC CONTROL OF RADIOSENSITIVITY IN YEAST. Haynes, R. H. (York Univ., Toronto). pp 529-540 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The following topics are discussed: advantages of yeasts for easily manipulated model systems for studies on molecular biology of eukaryotes; induction of x-ray-resistant mutants by radiations and chemicals; genetics of uv-sensitive mutants; loci of genes affecting radiosensitivity; gene interactions in multiple mutants; liquid-holding recovery; mitotic and meiotic recombination; and repair of yeast mitochondrial DNA. (HLW)

**12299** RADIATION-SENSITIVE MUTANTS OF YEAST. Game, J. C. (National Inst. for Medical Research, London). pp 541-544 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Nomenclature for various radiosensitive mutants of Saccharomyces cerevisiae is briefly discussed. Tables are presented to show results of allelism tests of most of the radiosensitive mutants isolated by various investigators together with a standardized rad locus designation and map positions of a number of rad loci in yeast. (HLW)

**12300** X-RAY-INDUCED DOMINANT LETHALITY AND CHROMOSOME BREAKAGE AND REPAIR IN A RADIOSENSITIVE STRAIN OF YEAST. Ho, K. S. Y.; Mortimer, R. K. (Univ. of California, Berkeley). pp 545-547 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The x-ray survival responses of different ploidy rad52 strains and of half-irradiated rad52/rad52 zygotes (dominant-lethal curves) are reviewed. Data from sedimentation velocity experiments which measured double-strand chromosomal DNA breakage and repair are discussed. (auth)

**12301** REPAIR OF DOUBLE-STRAND BREAKS IN CHROMOSOMAL DNA OF YEAST. Resnick, M. A. (Univ. of Rochester, NY). pp 549-556 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Ionizing radiation induces double-strand breaks in the nuclear DNA of the yeast Saccharomyces cerevisiae with an efficiency of approximately $0.6 \times 10^{-10}$ breaks/dalton-krad. Irradiation followed by incubation results in nearly all the breaks being repaired. Based on the efficiency of break production, the sensitivity of a rad52 mutant, and the absence of radiation-induced recombination in such a mutant, it is proposed that the corresponding gene product may be involved in double-strand break repair. A model involving recombination and DNA synthesis is described for this type of repair. (auth)

**12302** FATE OF UV-INDUCED PYRIMIDINE DIMERS IN THE NUCLEAR AND MITOCHONDRIAL DNAs OF SACCHAROMYCES CEREVISIAE ON VARIOUS POSTIRRADIATION TREATMENTS AND ITS INFLUENCE ON SURVIVAL AND CYTOPLASTIC "PETITE" INDUCTION. Waters, R.; Moustacchi, E. (Inst. du Radium-Biologie, Orsay, France). pp 557-565 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

The photoreactivability of uv-induced pyrimidine dimers in the nuclear and mitochondrial DNAs of Saccharomyces cerevisiae has been investigated in conjunction with the fate of these photoproducts following postirradiation dark incubation in saline and nutrient media. In all instances, survival and "petite" induction were measured. An attempt has been made to relate these results to present ideas on the repair of uv damages in DNA. (auth)

**12303** GENETIC CONTROL OF RADIATION SENSITIVITY AND DNA REPAIR IN NEUROSPORA. Schroeder, A. L. (Washington State Univ., Pullman). pp 567-576 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Radiation sensitivity in the fungus Neurospora crassa is under the control of at least eight distinct loci and is also affected by cytoplasmic factors. Although radiation-sensitive mutants which affect inter- or intragenic meiotic recombination have not been isolated, mutants which are defective in the repair of pyrimidine dimers have been found. Evidence from both mutational and biochemical studies shows that Neurospora has an excision-repair system for pyrimidine dimers which is very similar to the one found in Escherichia coli. Wild-type strains excise dimers, but two mutants, uvs2 and upr1, are uv sensitive and excision defective. Like the E. coli excision-defective mutants, the Neurospora mutants show a greatly increased frequency of uv-induced mutation at low uv doses, and they do not affect recombination. However, they differ from the E. coli mutants in being significantly more sensitive to ionizing radiation than wild-type strains. A third mutant, uvs6, resembles the DNA polymerase-I-negative mutants of E. coli. It is sensitive to both uv and x-irradiation, has a wild-type pattern of uv-induced mutation, and increases spontaneous deletion frequencies. Its polymerases have not been examined. The high frequency of uv-induced mutation in excision-defective strains suggests that a "mutation prone" system of DNA repair exists in Neurospora. (auth)

**12304** ENZYMES OF NEUROSPORA CRASSA WHICH ATTACK UV-IRRADIATED DNA. Fraser, M. J. (McGill Univ., Montreal). pp 577-579 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Two excision-deficient mutants of Neurospora crassa contain normal levels of two enzymes, a single-strand specific endonuclease, which attack uv-irradiated DNA. Mutants of N. crassa have been obtained in which the activity of the latter enzyme as well as an activity with native DNA are simultaneously affected. These activities are also apparently low in excision-proficient uvs3 strain of N. crassa which has many of the characteristics of the recA mutants of E. coli. (auth)

**12305** CONCERNING PYRIMIDE DIMERS AS "BLOCKS" TO DNA REPLICATION IN BACTERIA AND MAMMALIAN CELLS. Hewitt, R. R.; Meyn, R. E. (Univ. of Texas System Cancer Center, Houston, TX). pp 635-638 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Irradiated uv-sensitive bacteria which are mutant in the uvrA6 locus, and cannot excise pyrimidine dimers, are capable of continued DNA replication with the same orientation as that in unirradiated cells. Replication of dimer-containing DNA is also accomplished by irradiated mammalian cells, suggesting that pyrimidine dimers do not act as absolute blocks to DNA synthesis. Thus, the role that dimers play in reducing the amount and size of DNA synthesized after exposure must be reassessed. (auth)

**12306** USE OF HUMAN ADENOVIRUS 2 IN THE STUDY OF THE XERODERMA DNA-REPAIR DEFECT. Day, R. III. (NIH, Bethesda, MD). pp 747-752 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Ultraviolet-irradiated adenovirus 2 assayed by counting plaques on monolayers of human fibroblast strains is up to 30-fold more sensitive than normal if the strains used as viral hosts are prepared from persons having xeroderma pigmentosum. This plaque assay has been used as an extremely discriminating technique in the study of the xeroderma repair defect. With this assay, every xeroderma fibroblast strain tested has been found to exhibit a DNA-repair defect, including those previously judged by other methods to have normal DNA repair. (auth)

**12307** HOST-CELL REACTIVATION OF IRRADIATED HUMAN ADENOVIRUS. Rainbow, A. (McMaster Univ., Hamilton, Ont.). pp 753-754 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Irradiated adenovirus can be used to investigate DNA repair mechanisms in mammalian cells. Recent results suggest that the host-cell reactivation of irradiated human adenovirus reflects, in part at least, a postreplication repair mechanism in the host cell. (auth)

**12308** ANIMAL VIRUSES, RADIATION, REPAIR MECHANISMS, AND CANCER. Cameron, K. R. (Pennsylvania State Univ., Hershey). pp 755-761 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Effects of radiation on animal viruses are reviewed in terms of repair mechanisms and their possible relationship to virus transformation and carcinogenesis. Repair mechanisms are reviewed under the headings; multiplicity reactivation, photoreactivation, host-cell reactivation (dark repair), and uv reactivation. Other topics discussed are: transformation of cells in vitro by irradiated viruses, oncogenicity of virus-transformed cells in vivo, and possible role of repair mechanisms in virus transformation and oncogenesis. (HLW)

**12309** GENETICS OF USTILAGO VIOLACEA. I. Carotenoid Mutants and Carotenogenesis. Garber, E. D.; Baird, M. L.; Chapman, D. J. (Univ. of Chicago). Bot. Gaz. (Chicago); 136: No. 4, 341-346(Dec 1975).

Wild-type strains of Ustilago violacea produce pink colonies on laboratory medium and yield white, orange, pumpkin, and yellow colonies after uv mutagenesis. The wild-type strains contain neurosporene and lycopene; one orange mutant, gamma-carotene; and one yellow mutant, beta-carotene. One white mutant had no detectable carotenoids. Diploid colonies heterozygous for wild type and orange, pumpkin, yellow, or white are phenotypically wild type. Diploid colonies heterozygous for yellow and orange are also phenotypically wild type. Diploid colonies heterozygous for white and orange, white and yellow, and white, yellow, and orange are phenotypically light orange, light yellow, and orange-yellow, respectively. The white mutants give a circular complementation map; the color mutants fit a linear complementation map. We propose a multienzyme aggregate of four identical dehydrogenases and one or two identical cyclases for carotenogenesis in this species. The white and color mutants represent structural mutations altering the conformation of the dehydrogenase or cyclase, respectively. Furthermore, cyclases may or may not aggregate in association with the dehydrogenase aggregate to form the multienzyme aggregate responsible for the color mutants. (auth)

**12310** RADIATION STUDIES ON AZOTOBACTER CHROOCOCCUM. I. Photoreactivation and Dose Reduction Curve. Ahmed, M. H.; Venkataraman, G. S. (Indian Agricultural Research Inst., New Delhi). Zentralbl. Bakteriol. Parasitenk., Abt. II; 129: No. 3-4, 242-246(1974).

Lethal effects, produced by ultraviolet light (2537 Å) in six strains of Azotobacter chroococcum, can be reversed by light of longer wavelengths, administered after ultraviolet irradiation. Except in one strain (P3), a constant dose-reduction factor (DRF) appears to be untypical in this organism, the theoretical considerations of which are given. (auth)

## Radiation Effects on Plants

*Refer also to abstract 12294.*

**12311** (CONF-7404111-) USE OF RADIATIONS AND RADIOISOTOPES IN STUDIES OF PLANT PRODUCTIVITY. Proceedings of Symposium Held at Pantnagar, India, April 12–14, 1974. (Department of Atomic Energy, Bombay (India). Food and Agriculture Committee). 1974. 899p.

Separate abstracts were prepared for 17 sections of the conference. Two additional sections are included on microbiology and plant pathology. (HLW)

*For abstracts of individual sections see: 12045, 12046, 12312–12319, 12429, 12464, 12465, and 12472–12475.*

**12312** (CONF-7404111-, pp 1-84) INDUCED MUTATIONS FOR THE IMPROVEMENT OF CEREALS. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Studies were conducted on mutation breeding in rice for improved yield, improved grain quality, and leaf blight resistance using gamma radiation and EMS. A study was conducted on the role of low seed moisture in increasing the effectiveness of gamma rays for plant type and grain quality mutations in wheat. (HLW)

**12313** (CONF-7404111-, pp 85-107) INDUCED MUTATIONS FOR THE IMPROVEMENT OF MILLETS. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Experiments were conducted on mutation breeding in millet using fast neutrons, gamma radiation, and EMS. Results are reported for plant height, yield, and size of ears. (HLW)

**12314** (CONF-7404111-, pp 109-128) INDUCED MUTATIONS FOR THE IMPROVEMENT OF LEGUMES, OILSEEDS, AND TOBACCO. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Mutation breeding experiments were conducted on linseed to increase the yield of early-dwarf mutants using gamma radiation. Seeds of tobacco were treated with EMS and MMS; results are reported for effects on chlorophyll, pollen fertility, and morphology of leaves and stems. (HLW)

**12315** (CONF-7404111-, pp 129-150) INDUCED MUTATIONS FOR THE IMPROVEMENT OF FIBER CROPS. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Following gamma radiation, mutations for narrow leaves in cotton were reported. Seeds of cotton were treated with N-nitroso-methyl urea, EMS, and gamma radiation; mutations for yield, seed index, and boll weight are reported. Six varieties of hemp were treated with gamma radiation and mutations were observed for plant height, number of internodes, and other characteristics. (HLW)

**12316** (CONF-7404111-, pp 151-160) INDUCED MUTATIONS FOR THE IMPROVEMENT OF VEGETATIVELY PROPAGATED CROPS. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Japanese mint plants (Mentha arvensis) were treated with gamma radiation, EMS, ethylenimine, and methyl nitrosoguanidine for mutation breeding experiments. Results are reported for oil content, leaf abnormalities, leaf/stem ratio, and other characteristics. (HLW)

**12317** (CONF-7404111-, pp 161-168) NUCLEAR TECHNIQUES IN PLANT BREEDING. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

The protein content was determined by measuring nitrogen content of rice, wheat, maize, sorghum, mung, and ground nut. Results of chemical analyses were compared with those of activation analysis using 14 MeV neutrons. Good agreement between the two methods was obtained. (HLW)

**12318** (CONF-7404111-, pp 169-186) INDUCED MUTANTS IN ORNAMENTAL PLANTS. 1974.

Bulbs of tuberoses (Polianthes tuberosa) were treated with gamma radiation. Results are reported for percent of bulbs sprouting; average number of leaves per plant; average length of longest leaf; morphological abnormalities in leaves, flowers, and bulbs; and average height of flowering stalk. Eight varieties of Canna were treated with gamma radiation, and results are reported for effects on germination, survival, and flower color. (HLW)

**12319** (CONF-7404111-, pp 187-228) RADIATION INDUCED GROWTH STIMULATION. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Results are reported for the following studies: comparative study of low and high dose x-irradiation of barley seeds during germination and early seedling growth; biochemical changes associated with gamma irradiation of Phaseolus mungo seeds in roots during juvenile differentiation; effect of gamma rays on fibres of Sida rhombifolia; and radioinduced stimulation in rice. (HLW)

**12320** (INIS-mf-1830) EFFECTS OF GAMMA IRRADIATION ON HETEROSIS IN SINGLE HYBRID CORN (ZEA MAYS L.). Tulmann Neto, A. (Sao Paulo Univ., Piracicaba (Brazil). Escola Superior de Agricultura Luiz de Queiroz). 1972. 72p. (In Portuguese). INIS.

Thesis.

The principal objective was to analyze the effects of gamma-rays on heterosis in single hybrid corn. Seeds of two homozygous inbred lines, one of dent and another of flint corn, were the material used. The dose applied was 3.7 KR with a dose rate of 0.116 KR per minute. The irradiated and non-irradiated material were sown in the field, with self-fertilization and all the possible combinations of crosses between these two, resulting in 16 treatments in total were realized. Seeds derived from these treatments were sown again in the field with lattice square balanced design, $4 \times 4$, with 10 replications. Maternal and reciprocal effects, irradiation effects on the mean variance, mean of the various treatments and regression between the mean and irradiation level were analyzed, and besides these, effects of gamma-irradiation on heterosis were also estimated on various quantitative characters. (INIS)

**12321** (KURRI-TR-120, pp 49-54) CHARACTERISTICS OF PHOTODYNAMIC ACTIVITY AND RECONSTRUCTION OF CELLS. Ito, T. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

The characteristics of photodynamic activity (PD) in the cell level were studied, and the application of conception of the cell reconstruction seen in the cases damaged by the ultraviolet ray (UV) and x-ray to the cases with PD activity was examined. First, damages and reconstruction in nucleic acid by UV and x-rays and those by PD activity were outlined. In addition, our examination on PD activity to yeast cells was reported. Both the lethality and genetic change were larger in 40 nm than 510 nm. This suggested the differences in PD activity in binding conditions, but further studies are needed to elucidate what kind of damage is related to this. The examination using the yeast cell group with synchronized division showed that the maximum sensitivity was not observed in DNA synthesis time, but in the nuclear division time. This led to the presumption that DNA with PD activity has different condition from that with UV and x-rays. Finally, the conflicting results obtained from experiments on reconstruction in E. coli were reported. (JA)

**12322** (KURRI-TR-120, pp 65-66) RADIATION EFFECTS ON DRIED SEEDS. Yamaguchi, H. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

Gamma irradiation was given to seeds in the liquid nitrogen, and temperature was made to increase as the time of measurement. Then, thermoluminescence was measured. In order to study the relationship between radiation damage and thermoluminescence, five species of soy beans with different sensitivity to radiation were selected, and changes in luminescence amounts with time and the relationship between irradiation doses and luminescence effects were obtained. In addition, paramagnetic ion containing in the embryo of the soy beans was detected by activation analysis. There was a difference among species in the amounts of paramagnetic ion. From the study on the relationship between radiosensitivity and the amounts of paramagnetic ion, radiosensitivity was higher with increase of Mn amounts. Soy beans were selected as subjects. Gamma rays were irradiated to dried seed, and nucleic acid was extracted. And then, fraction was done with MAK column chromatography. While there were almost no changes by irradiation in the radioresistant species, there was decomposition of ribosome RNA by irradiation in the radiosensitive species. DNA was quantified in barley and the molecular weight was calculated. The number of single-strand breaks of DNA was linearly increased with the increase of irradiation doses. Single-strand breaks of DNA which were produced by irradiation, mainly 5' telosynapsis was studied. (JA)

**12323** (ORO-2583-15) CYTOLOGICAL STUDY OF RADIATION INDUCED ALTERATIONS IN CYTOPLASMIC FACTORS CONTROLLING MALE STERILITY IN CORN. Progress Report, February 28, 1975–December 1, 1975. Edwardson, J. R. (Florida Univ., Gainesville (USA). Inst. of Food and Agricultural Sciences). 1975. Contract AT(40-1)-2583. 14p. Dep. NTIS $4.50.

Progress is reported on the following research projects: cytoplasmic constituents of the embryo of various gymnosperms and angiosperms; cytoplasmic male sterility in corn; modification of cytoplasmic sterility factors using gamma radiation, EMS, and ethidium bromide; selection for sterile, blight-resistant corn plants; electron microscopy study of abnormal mitochondria in cytoplasm of corn; cytoplasmic male sterility in Petunia; non-Mendelian variegation in Petunia and Nicotiana; graft transmission of cytoplasmic male sterility; cytoplasmic male sterility in Vicia faba; and studies on Blakeslee's I virus in Datura. (HLW)

**12324** EFFECT OF TEMPERATURE ON RADIATION-INDUCED MACROMUTANTS OF ARACHIS HYPOGAEA L. AND EXPRESSION OF HETEROSIS IN $F_1$ HYBRID POPULATIONS. Carlson, S. K.; Emery, D. A.; Wynne, J. C. (North Carolina State Univ., Raleigh). Radiat. Bot.; 15: No. 3, 199-213(Sep 1975).

Three separate experiments were conducted with cultivated peanuts to (a) study the effect of four controlled temperatures on the expression of seven radiation-induced macromutants and the mother line; (b) determine the responses of normal appearing $F_1$ hybrids involving four macromutants to three controlled temperature regimes and (c) evaluate the same macromutant, parental and $F_1$ hybrid populations (described in b) when grown for a full season under field conditions. Macromutant plant weights and flower production were generally lower than that of the mother line in all three experiments. The macromutants also tended to flower later than the mother line. The leaflet expression of two of the macromutants was drastically influenced by changes in temperature. Lupinus reached maximum leaflet

curvature when grown at 34/30°C but appeared near normal when grown at 22/18°C. The reverse was true for the macromutant Recurved. The macromutant Flop contained maximum percentages of nitrogen and phosphorus in its vegetative parts when grown at the highest temperature (34/30°C). All other mutants and the mother line had highest proportions of these nutrients when grown at the lowest temperature regime (22/18°C). Expressions of heterosis were maximized when hybrids of macromutant parentage were grown at suboptimal temperatures. General combining ability estimates were higher than specific combining ability estimates with the macromutant Hedera (a dwarf type) making the greatest contribution to the general combining ability effects for peg (fruit-bearing structure) production and pegging efficiency. The same macromutant was found to make substantial contributions to general combining ability effects for fruit and seed weight when hybrids were grown under field conditions. (auth)

**12325** USE OF HYDROGEN SULPHIDE AND n-ETHYLMALEIMIDE IN THE POST-IRRADIATION MODIFICATION OF OXIC AND ANOXIC COMPONENTS OF DAMAGE IN HORDEUM VULGARE. Sharma, G. J.; Kesavan, P. C. (Jawaharlal Nehru Univ., New Delhi). Radiat. Bot.; 15: No. 3, 261-266(Sep 1975).

The post-irradiation modification of radiosensitivity of barley seeds with about 7% water content by hydrogen sulphide and n-ethylmaleimide (NEM) applied during oxygenated or oxygen-free hydration was studied. $H_2S$, which caused about 18% seedling injury to unirradiated seeds, effectively decreased the post-irradiation oxygen-dependent damage (Powers' class III). NEM dramatically enhanced the magnitude of an $O_2$-independent component of damage. It also afforded a small degree of protection against the post-irradiation oxic damage. The mechanisms possibly involved are briefly discussed. (auth)

**12326** EFFECTS OF ACUTE GAMMA IRRADIATION AND DEVELOPMENTAL STAGES ON GROWTH AND YIELD OF RICE PLANTS. Igbal, J.; Zahur, M. S. (Univ. of Punjab, Lahore). Radiat. Bot.; 15: No. 3, 231-240(Sep 1975).

Rice plants were exposed to 1, 2.5, 5, 7.5, and 10 kR of acute gamma rays at four critical developmental stages, i.e., pre-tillering, ear-primordia formation, meiosis, and heading. Doses of 1 and 2.5 kR, in general, had a stimulatory effect on culm length, tillering, ear number per plant, spikelet number per ear, and seed yield per plant, at the first two developmental stages, particularly at the pre-tillering stage. There was a significant reduction in all the above characters at 5 and 7.5 kR for all irradiated stages. Of the different developmental stages, pre-tillering was most radiosensitive ($LD_{100}$ 7.5 kR), followed by meiotic and heading stage. Stage of development, exposure rate, and differences in interphase chromosome volume (ICV) are discussed as possible factors affecting radiosensitivity. (auth)

**12327** HISTOCHEMICAL EVIDENCE FOR THE RELATIONSHIP BETWEEN PEEL DAMAGE AND THE ACCUMULATION OF PHENOLIC COMPOUNDS IN GAMMA-IRRADIATED CITRUS FRUIT. Riov, J. (Hebrew Univ., Rehovoth, Israel). Radiat. Bot.; 15: No. 3, 257-260(Sep 1975).

The first symptoms of radiation damage to citrus fruit were noted 24 to 48 hr after irradiation with 240 krad of gamma rays. At about the same time, radiation-damaged cells were observed in peel cross sections in the flavedo, the outer colored peel layers. The damaged cells were deformed and their protoplasts stained much darker with haematoxylin-safranin than protoplasts of intact cells. The cytoplasm in damaged cells either thickened at one side of the cell, sometimes filling up most of the cell space, or contracted into a small mass. Using several histochemical reagents, a considerable accumulation of phenolic compounds was found to occur in the damaged cells shortly after irradiation. No accumulation of phenolic compounds was observed in intact cells of irradiated fruit. It is suggested that the phenolic compounds which accumulate in flavedo cells following irradiation cause cell death and consequent peel necrosis (pitting). (auth)

**12328** SYNERGISTIC EFFECT OF COMBINED TREATMENTS OF GAMMA RADIATION AND ETHYL METHANESULFONATE IN BARLEY. Khalatkar, A. S.; Bhatia, C. R. (Bahaba Atomic Research Centre, Bombay). Radiat. Bot.; 15: No. 3, 223-229 (Sep 1975).

In these experiments $^3$H-labelled ethyl methanesulfonate (EMS) was used to study the effect of gamma rays on the uptake of EMS by barley seeds and the resultant alkylation of macro-molecules. In a parallel experiment the combined effect of gamma rays and EMS on mutation frequency and efficiency was investigated. Gamma irradiation (10, 20, and 30 kR) inhibited the uptake of [$^3$H]-EMS, resulting in fewer alkylations in the macromolecular fraction. In the combined treatments with unlabelled EMS, seedling injury as well as frequency of mitotic and meiotic chromosomal aberrations were less than additive. However, a synergistic effect of combined treatment was observed for the induction of chlorophyll mutations in the $M_2$ generation. The results rule out the increased uptake of the chemical mutagen as the cause of the observed synergism, and suggest the interaction of radiation- and chemically-induced lesions. (auth)

**12329** EFFECT OF GAMMA IRRADIATION ON CELL PROLIFERATION AND REGENERATION IN EXPLANTED TISSUES OF PIGEON PEA: CAJANUS CAJAN (L). Mills, P. Rao, H. K. S.; Narayanaswamy, S. (Bhabha Atomic Research Centre, Bombay). Radiat. Bot.; 15: No. 3, 301-305(Sep 1975).

Effects on the developmental morphology of Cajanus seeds irradiated with $^{60}$Co gamma rays have been investigated in vitro. Seeds exposed to 5 kR produced a cluster of adventitious roots on a callusing medium (modified Murashige and Skoog nutrient solution) while the hypocotyl explants of germinated seedlings were stimulated to cell proliferation and abundant callusing which, on a differentiating medium (modified medium) regenerated shoot buds and plantlets. In controls and with higher doses growth was limited to the development of a spongy tissue to form a small callus mass from seeds and a restricted callus proliferation from excised hypocotyls of irradiated seeds. Only calluses exposed to 5 kR differentiated plantlets. However, callus tissues derived from the 5 kR treatment were highly friable and amenable for release of protoplasts in large numbers on enzymatic digestion of cell walls of cells grown as suspensions. Mesophyll cell protoplasts obtained from the tissue culture-induced plant showed spontaneous adhesion and fusion. (auth)

**12330** X-RAY INDUCED FUSED PERIANTH IN RICINUS COMMUNIS (L). Subramanian, M.; Sivasubramanian, P. (Agricultural Coll., Madurai, India). Radiat. Bot.; 15: No. 3, 307-308(Sep 1975).

Dried and soaked seeds of Ricinus communis L. cv Tindivanam, two were treated with X rays ranging from 10 kR to 100 kR with 10 kR increments. The mutants were studied for their variability. Three mutants possessing all the staminate flowers with fused perianth were spotted in the $M_2$ population obtained by treating the dried seeds at 30 kR; the breeding behavior of these mutants in $M_3$ and their importance in hybrid seed production are discussed. (auth)

**12331** MOLECULAR MECHANISMS FOR DNA REPAIR IN THE BLUE-GREEN ALGAE. Kraus, M. P. (Univ. of Delaware, Newark). pp 525-528 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Techniques and materials used in studies on DNA repair in blue-green algae are described. Mechanisms of repair are discussed with regard to dark repair enzymes, photoreactivation, lysogenic induction, and recombinations of gamma-irradiated superinfecting cyanophage. (HLW)

**12332** ABSENCE OF PYRIMIDINE DIMER EXCISION AND REPAIR REPLICATION IN CHLAMYDOMONAS REINHARDTI. Swinton, D. C. (Univ. of Chicago). pp 585-588 of Molecular Mechanisms for Repair of DNA. Part B. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PB.

Chlamydomonas reinhardti is shown to be incapable of performing excision-repair on either its chloroplast or nuclear DNA, since neither repair replication nor pyrimidine dimer excision occurs in either genome. (auth)

**12333** MICROSPORES IRRADIATION IN ANTHER CULTURE: TESTING A NEW TECHNIQUE TO OBTAIN MUTATIONS IMMEDIATELY DETECTED AND FIXED (APPLICATION TO NICOTIANA TABACUM). Mondeil, F. (Paris-11 Univ., 91- Orsay (France)). Ann. Amelior. Plantes; 24: No. 1, 1-11(1974). (In French).

In order to consider the effects of microspores irradiation on embryo development, and in order to observe the morphological responses of haploid plantlets derived from androgenetic anthers to ionizing irradiation, 1000, 1500 and 2000 R of gamma rays were delivered on anthers of Nicotiana tabacum ($DL_{50}$ range calculated: 1500 R). The cytological studies of embryo development revealed an apparent increase in irradiated microspores: cell division is stimulated but followed by an early mortality. A sharp rise in lethality effects was observed when gamma rays were applied beyond the seventh day of culture, when the proembryo contains an average of four cells. Morphological aberrations and color changes in the Mo progeny derived from irradiated microspores are diverse. But after chromosome doubling and mutation

checking out, all the plants were not recorded to have transmitted their aberrant characters. Thus, heritable character (mutations) and not heritable character (variations) were obtained. The variations characters include dwarfing, excessive branching, fasciation and dichotomy of the stems, and altered flower form, expecially of petals. As to the leaves, they usually show induced changes in their color (chlorotic areas, mosaic-color changes, or an over-all color change), in their form (irregularity in outline), and in their texture (thickening, hairless leaf). Among the mutants, a monster tobacco, with excrescences on the leaves and the flowers is certainly the most conspicuous. But mutants also include altered leaf color (over-all pale green) and altered flower color (dark red, clear pink, white). (FR)

**12334** DISJUNCTION OR NON-DISJUNCTION IN $F_2$ GENERATION ACCORDING TO THE CROSS BETWEEN A WHEAT MUTANT AND ITS ORIGINAL LINES. Touvin, H. (Institut de Recherches Agronomiques (INRA), 21- Dijon (France). Station d'Amelioration des Plantes). Ann. Amelior. Plantes; 23: No. 3, 209-220(1973). (In French).

The existence of a major gene for earliness can be supposed, the expression of which appears to be under the control of the cytoplasm. The conclusion emphasizes the importance of the reciprocal crosses in the use of the mutants. (FR)

**12335** RELATION BETWEEN LUMINESCENCE SIGNALS AND THE EPR SPECTRA OF IRRADIATED SEEDS OF PISUM SATIVUM. Asaturyan, R. A.; Avakyan, Ts. M. (Erevan Inst. of Physics). Biofizika; 19: No. 6, 879-883(Sep 1974). (In Russian).

In unirradiated cotyledons and seed nuclei of Pisum sativum of the species Victoria, ions of $Mn^{2+}$ were detected. The EPR spectrum of the seed covering is a singlet of width 7 ± 1 oe with a g-factor of 2.0048. A correlation is found between the intensity of the very weak luminescence in the stable phase and the relative concentration of radicals in x ray-irradiated, pea seeds as a function of dose, temperature shock (TS), and temperature shock (TS) with subsequent irradiation at various doses. In irradiated seeds a determination was made of radicals of two types (short- and long-lived), which do not belong to peroxides. An attempt is made to associate the luminescence signals with conversions of these radicals. (tr-auth)

**12336** EFFECT OF THE CALCIUM-TO-MAGNESIUM RATIO IN THE FEED SOLUTION ON THE GENETIC CONSEQUENCES OF IRRADIATING CABBAGE SEEDS WITH GAMMA RAYS. Shaidorov, Yu. I. Kosm. Biol. Med.; 8: No. 6, 28-32(Nov 1974). (In Russian).

A study was made of the Ca/Mg ratio in the feed solution on the manifestation of a radiobiological effect from gamma rays. It is shown that the growing of plants from irradiated seeds in solutions with the same concentration and anion composition but with a different Ca/Mg ratio leads to a change in the radiobiological effect. An increased content of calcium decreases the biological effect of radiation, while an increased content of magnesium increases this effect. (tr-auth)

**12337** EFFECT OF MOISTURE CONTENT AND OF X RADIATION DOSES ON THE YIELD OF VITAL MUTANTS OF SPRING BARLEY. Velikovsky, V. (Research Institut of Cereal Crops, Kromeriz (Czechoslovakia)). Genet. Slechteni; 10: No. 3, 171-178(1974). (In Czech).

The effect was studied of moisture content of spring barley irradiated with various x-ray doses on mutation frequency and on the frequency of vital mutants. As against seeds with a normal moisture content, the seeds that had been dried and subsequently moistened with water were found to show a higher mutation frequency. A four-fold increase was found in the number of mutant strains applicable in practical purposes. The strains had a higher protein content and some of them also showed a better resistance to powdery mildew. (INIS)

**12338** INDUCTION AND APPLICATION OF SHORT-STALKED MUTATIONS IN OATS. Votava, V.; Nasinec, J. (Breeding Station, Vetrov (Czechoslovakia)). Genet. Slechteni; 10: No. 3, 179-186(1974). (In Czech).

Short-stalked mutations are described obtained from the Sumavsky variety oats by doses of 19 kR, 22 kR, and 25 kR of x radiation applied to seeds containing 14% of moisture. The effect was also studied of the x radiation doses on the frequency of suitable mutations. (INIS)

**12339** EFFECT OF GAMMA-RADIATION ON THE GROWTH OF PRIMARY AND "LONG-TERM" TISSUE CULTURES (NICOTIANA TABACUM L.). Opatrny, Z. (Ceskoslovenska Akademie Ved, Prague. Ustav Experimentalni Botaniky). Biol. Plant. (Prague); 16: No. 6, 418-425(Nov 1974).

The growth of primary (cv. Wisconsin 38) and long-term (cv. Virginia Bright Italia) tissue cultures obtained from Nicotiana tabacum L. pith was affected by exposure to a single dose of gamma radiation ranging from 1 to 150 krad. The inhibitory effect was proportional to the applied dose. Changes in the degree of inhibition during the subculture interval were ascertained by quantitative evaluation of the growth response. Primary cultures proved to be several times more radiosensitive than long-term cultures. Possible reasons of these differences are discussed. (auth)

# Radiation Effects on Animals

## Man

*Refer also to abstracts 11498, 11525, 12010, and 12035.*

**12340** (CONF-7410141-1) FILM TECHNIQUES IN RADIOTHERAPY FOR TREATMENT VERIFICATION, DETERMINATION OF PATIENT EXIT DOSE, AND DETECTION OF LOCALIZATION ERROR. Haus, A. G.; Marks, J. E. (Franklin McLean Memorial Research Inst., Chicago, Ill. (USA)). 1974. 15p. Dep. NTIS $4.50.

From 14th annual fall symposium of the Society of Photographic Scientists and Engineers; Washington, District of Columbia, USA (24 Oct 1974).

In patient radiation therapy, it is important to know that the diseased area is included in the treatment field and that normal anatomy is properly shielded or excluded. Since 1969, a film technique developed for imaging of the complete patient radiation exposure has been applied for treatment verification and for the detection and evaluation of localization errors that may occur during treatment. The technique basically consists of placing a film under the patient during the entire radiation exposure. This film should have proper sensitivity and contrast in the exit dose exposure range encountered in radiotherapy. In this communication, we describe how various exit doses fit the characteristic curve of the film; examples of films exposed to various exit doses; the technique for using the film to determine the spatial distribution of the absorbed exit dose; and types of errors commonly detected. Results are presented illustrating that, as the frequency of use of this film technique is increased, localization error is reduced significantly. (auth)

**12341** (COO-3017-23) SAFE HANDLING OF TISSUE CONTAINING RADIOACTIVE SUBSTANCES. Warren, S. (New England Deaconess Hospital, Boston, Mass. (USA)). 1975. Contract E(11-1)-3017. 6p. (CONF-751143-1). Dep. NTIS $4.50.

From meeting on safe handling of tissue containing radioactive substances; Philadelphia, Pennsylvania, USA (7 Nov 1975).

Patients recently treated with radioactive isotopes may present problems or even hazards during physical examination, surgery, or autopsy, especially following the use of $^{131}I$ and $^{198}Au$. $^{32}P$ is rarely a significant hazard. Contamination of victims of radiation accidents may be a problem initially, but they are usually promptly decontaminated. Guidance of the hospital's radiation safety officer is helpful, particularly with regard to handling of contaminated persons or materials. Long-lived isotopes, such as radium or thorotrast, are usually present in too low concentration to be dangerous. (auth)

**12342** (DP-MS-75-29) MEASURED PLUTONIUM RESUSPENSION AND RESULTING DOSE FROM AGRICULTURAL OPERATIONS ON AN OLD FIELD AT THE SAVANNAH RIVER PLANT IN THE SOUTHEASTERN UNITED STATES. Milham, R. C.; Schubert, J. F.; Watts, J. R.; Boni, A. L.; Corey, J. C. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 17p. (CONF-751105-12; SM-199/83). Dep. NTIS $4.50.

From IAEA international symposium on transuranium nuclides in the environment; San Francisco, California, USA (17 Nov 1975).

Plutonium resuspensions, based on air-sample activity, were measured during field preparation and planting of winter wheat at the Savannah River Plant (SRP). Plutonium was originally deposited in the field during the previous twenty years as a result of atmospheric releases from SRP's nuclear fuel processing facility located adjacent to the field, and from global fallout following nuclear weapons tests conducted at other sites. During soil cultivation when the prevailing wind speed ranged from 0 to 6.3 m/sec, airborne plutonium upwind of the field consistently averaged 1.7 femtocurie/$m^3$. Airborne plutonium concentrations during the various activities associated with site preparation and planting averaged 210 femtocurie/$m^3$ at 7.6 m and 10 femtocurie/$m^3$ at 30.5 m downwind from the edge of the field. The air at face level on the tractor contained 49 femtocurie/$m^3$. The average concentration of plutonium in the 0 to 5 cm soil layer following cultivation was 3100 femtocurie/g. Dose calculations based on measurements of resuspended plutonium indicated that the 70-year bone-dose commitment to an agricultural worker after one hundred 8-hour days would be 49 mrem, 210 mrem,

or 1.8 mrem, depending on whether the worker remained in the tractor seat, 7.6 m downwind of the edge of the field, or 7.6 m upwind of the edge of the field. Resuspension factors for the agricultural activities were $103 \times 10^{-8}$ $m^{-1}$ at 7.6 m downwind, $5 \times 10^{-8}$ $m^{-1}$ at 30.5 m downwind from the edge of the field, and $24 \times 10^{-8}$ $m^{-1}$ at the tractor location. (auth)

**12343** (ERDA-tr-91) STATE OF IMMUNITY OF THE POPULATION DURING INCREASE IN ENVIRONMENTAL RADIOACTIVITY. Mehring, C. E. [nd]. Translation of a German Report. 20p. Dep. NTIS $3.50.

Data are summarized on the health status of residents of Hamburg during the past 20 years. The relationship of fallout radioactivity to immunity to diseases is discussed. (CH)

**12344** (INIS-mf-1746) RADIATION PROTECTION REGULATORY GUIDES FOR THE GENERAL POPULATION AND ENVIRONMENTAL RADIOACTIVE CONTAMINATION CONTROL IN MEXICO. Magidin M, R. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Quimica). 1974. 140p. (In Spanish). INIS.

The philosophy of radiological protection expressed by the International Commission of Radiological Protection, the International Organization of Atomic Energy, and other international and national organizations is applied to the development of the best safety standards. The dose limits proposed by ICRP for individuals of the critical population are justified under normal conditions on the basis of statistical data from Mexico. Derived contamination levels and the contamination levels in various substrata are fixed using as base the available data for the population and food habits of the Mexican population. The probability of exposure of individuals to higher doses than the accepted limits are only slightly probable. The mean age of procreation was established and the genetically significant admissible dose was determined for the population in general. On the base of statistics on mortality from accidents in the Mexican Republic "obligatory" action levels were fixed and the considerations which should be taken into account in developing necessary emergency measures in the case of accidental exposure are indicated. (tr-INIS)

**12345** (KURRI-TR-120, pp 45-48) INITIAL PROCESS OF PHOTO-SENSITIZATION BY PIGMENTS. Ito, T. 20 Sep 1973. (In Japanese)

From study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism; Kumatori, Osaka, Japan (May 1973).

In proceedings of the study meeting on initial stage in the biological effect of radiation and the chain reparation mechanism.

Photosensitization by pigments was outlined, mainly referring to sensitizing activity of acridine orange (AO). Mechanism of sensitizing activity was analyzed, and the characteristics of sensitized activity in the living body was discussed considering the following problems: (1) transference and exchange of energy between bound pigments and molecules; (2) possibility of promotion of $^3D$ production in AO-bound conditions and the stabilization; (3) reaction of the pigment-absorbed substances; (4) various effects on scheme of bound conditions. As for the AO sensitizing activity in the living body, the facts were pointed out that the binding of nuclear acid and AO is the basis of sensitization of cell lines and that AO bound to the parenchyma has photo-sensitizing activity. Moreover, it was found that $H_2O$ is inevitable for inactivation of tRNA trypsin in solid condition in which $O_2$ is present and parenchyma is in contact with sensitizing pigments. Problems on conformation of parenchyma were also referred to. Finally, photosensitizing activity of AO on the biochemical molecules in the living body and effects of ultraviolet and x rays were compared. (JA)

**12346** (N-75-16212) TOTAL BODY CALCIUM ANALYSIS. Annual Report, 1 November 1972-1 October 1974. Lewellen, T. K.; Nelp, W. B. (Washington Univ., Seattle (USA)). 9 Nov 1974. Contract NAS9-13029. 46p. (NASA-CR-141573). NTIS $3.75.

A technique to quantitate total body calcium in humans is developed. Total body neutron irradiation is utilized to produce argon-37. The radio argon, which diffuses into the blood stream and is excreted through the lungs, is recovered from the exhaled breath and counted inside a proportional detector. Emphasis is placed on: (1) measurement of the rate of excretion of radio argon following total body neutron irradiation; (2) the development of the radio argon collection, purification, and counting systems; and (3) development of a patient irradiation facility using a 14 MeV neutron generator. Results and applications are discussed in detail. (STAR)

**12347** (ORNL-TM-5139) EPICENTER OF THE NAGASAKI WEAPON: A REANALYSIS OF AVAILABLE DATA WITH RECOMMENDED VALUES. Kerr, G. D.; Solomon, D. L. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 29p. Dep. NTIS $5.00.

A significant source of uncertainty in estimates of radiation dose for atomic-bomb survivors of Nagasaki and in correlations of radiation dose with medical effects observed in these survivors is due to unresolved discrepancies in the literature with respect to the location of the epicenter or burst point of the weapon. Available data on the epicenter of the weapon have been reanalyzed in this report using several different approaches. These appear to have resolved some of the major discrepancies found in the literature and to justify a recalculation of radiation doses for the atomic bomb survivors of Nagasaki. A recommended epicenter for recalculating the radiation doses is given in the report. (auth)

**12348** (REG/G-8.13(Rev.1)(11-75)) INSTRUCTION CONCERNING PRENATAL RADIATION EXPOSURE. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Nov 1975. 5p. NUREG.

Occupational exposures to radiation are being kept low. However, qualified scientists have recommended that the radiation dose to an embryo or fetus as a result of occupational exposure of the expectant mother should not exceed 0.5 rem because of possible increased risk of childhood leukemia and cancer. Since this 0.5 rem is lower than the dose generally permitted to adult workers, women may want to take special actions to avoid receiving higher exposures, just as they might stop smoking during pregnancy or might climb stairs more carefully to reduce possible risks to their unborn children. (auth)

**12349** (SAAS-179) POSSIBILITIES OF USE OF MODERN SOLID-STATE DOSIMETERS FOR CENTRAL PERSONNEL MONITORING. Herrmann, D.; Kraus, W. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Jun 1975. 37p. (In German). Dep. NTIS (US Sales Only) $4.00.

The experiences during several years with different personnel dosimeters for $\gamma$ and x-ray measurements are presented. The dosimeters were irradiated in a phantom by known doses, as well as used in routine personnel monitoring. Under laboratory conditions film, thermoluminescent LiF, and photoluminescent glass dosimeters proved to be nearly equivalent with regard to measuring accuracy. For economical and organizational reasons photoluminescent dosimeters are not considered for future use in GDR monitoring service. Parallel monitoring of 332 occupationally exposed persons during a 12 month period with film and LiF/teflon dosimeters showed the latter to be well suited for this task. Their introduction into routine monitoring instead of film dosimeters depends on the availability of appropriate evaluation instruments and on economical considerations. (auth)

**12350** (SAAS-182) RECOMMENDATIONS ON STANDARDIZATION IN X-RAY DIAGNOSTICS. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)). Jul 1975. 41p. (In German). Dep. NTIS (US Sales Only) $4.00.

Recommendations are given for standardization in diagnostic radiology of the chest organs, the stomach, duodenum, the gall bladder and bile ducts, and in intravenous urography. The implementation of these recommendations is to enable both optimization of diagnostic information and reduction of patient dose. (auth)

**12351** (UCRL-50025-75-4, pp 13-17) RECONSTRUCTING THREE-DIMENSIONAL IMAGES FROM TWO-DIMENSIONAL MEDICAL X-RAYS. 8 Oct 1975.

In Electronics Engineering Department quarterly report No. 4, 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.).

Computer reconstruction techniques were developed to produce three-dimensional images from two-dimensional medical x-ray data. Multiple radiographic shadowgraphs, each representing an x-ray density through an object from a different angle, are used to reconstruct three-dimensional images of cross sections through the object being x rayed. These cross-sectional images, then, are recorded and displayed on a television screen, making it possible to produce three-dimensional video pictures of dynamic organs, such as the beating heart. (auth)

**12352** (UNI-SA-15) AUDITABLE PROGRAM OF COMPLIANCE WITH ALAP. Munson, L. H.; Freytag, L. A. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 12 Nov 1975. Contract AT(45-1)-1857. 12p. (CONF-760202-15). Dep. NTIS $4.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Increasing public and governmental pressure is being felt by all sectors of the Nuclear Industry to demonstrate compliance to maintaining occupational radiation exposures as low as practicable (ALAP). This paper describes a systematic approach to occupa-

tional radiation exposure reduction which will not only reduce radiation exposure usage but will provide an auditable record of compliance with ALAP. The essential features of the program include guidelines for identification and appreciation of tasks which involve significant amounts of radiation exposure, the contribution of the Health Physicist in reducing radiation exposure, and a matrix for evaluation of feasibility, practicality, and economics of each application. (auth)

**12353** DOXORUBICIN, RADIOTHERAPY, AND OESOPHAGEAL STRICTURE. Horwich, A. (Sidney Farber Cancer Center, Boston); Lokich, J. J.; Bloomer, W. D. Lancet; 2: No. 7934, 561-562(20 Sep 1975).

Case histories are described for two patients in whom esophageal stricture developed after concomitant doxorubicin (daunorubicin) and radiotherapy for oat-cell carcinoma of the lung. Primary disease, treatment, and time to development of esophageal stricture were almost identical in the cases cited. One patient also received a short course of bleomycin (total dose 40 mg. per sq. m.), and in addition has oral (and possibly esophageal) moniliasis. There are no reports of esophageal stricture as a side effect of therapy with doxorubicin or other chemotherapeutic agents alone (Blum, R. H., Carter, S. K., Ann. Intern. Med., 1974, 80:249). Radiotherapy has been reported as producing this side effect, though rarely at doses of less than 6000 rad and rarely after radiotherapy of less than 3 months' duration (Seaman, W. B., Ackerman, L. V., Radiology, 1957, 68:534). The strictures in these cases were thus remarkable, firstly because they appeared quite so soon after radiation (8 to 9 weeks) and secondly because the dose of radiation to the esophagus was relatively low (4500 and 5000 rad). It is therefore suggested that these esophageal strictures resulted from the local interaction of doxorubicin and radiation, with enhancement of the toxic effect of the latter. (UK)

**12354** RADIATION-INDUCED PSEUDOARTHROSIS. Kolar, J.; Bek, V.; Vrabec, R.; Jakoubkova, J.; Suna, Z. Cesk. Radiol.; 28: No. 6, 377-384(1974). (In Czech).

Radiation-induced pseudoarthrosis still remains one of the possible complications of radiation therapy particularly in the case of a malignant neoplasm. Their prognosis improved substantially with the aid of active surgical approach, supported by antibiotics. The number of inflammatory complications decreased substantially and the success of operative treatment in nearly one third of 37 patients reported here documents that surgical approach remains a method of choice. In addition to several radiographic pictures the authors document more extensively a case of pseudoarthrosis in hypoplastic scaphoid hitherto not reported in the medical literature. (auth)

**12355** OVER-EXPOSURE FROM WORKING WITH AN X-RAY CRYSTALLOGRAPHY SET. Crossan, I. F. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 13, 19-20(Oct 1975).

A service engineer was engaged in setting up and aligning a goniometer for use with a new x-ray generator and tube stand in the physics department of a university. The goniometer was of an old type, not matching with the shutter system of the tube shield. A piece of brass tubing 4 cm in length was being used as a temporary enclosure for the useful x-ray beam, but the engineer realized after about four hours operation that the useful beam was not totally enclosed. A film badge worn by the engineer at waist level recorded a dose of less than 0.2 rems, but the generator table had possibly shielded it. A later reconstruction of the incident produced an estimate of 2 rems as the dose to the engineer's trunk surface. It was impossible to estimate the dose to his hands and wrists resulting from direct exposure to the x-ray beam, but the dose received must have been below 500 to 600 rems, since no unusual skin effects have subsequently been detected. The incident demonstrates the need for adequate training, frequent monitoring especially when the useful beam is not totally enclosed, and an appreciation of the hazards involved when working with crystallographic equipment generating very intense x-ray beams. The combination of pieces of equipment made by different manufacturers requires particular care. Maintenance and alignment of modern crystallographic apparatus can also be hazardous to inexperienced operators. (UK)

**12356** CONVERSION OF BETA-RAY DOSE RATES MEASURED IN AIR TO DOSE RATES IN SKIN. Heinzelmann, M. (Kernforschungsanlage, Juelich, Ger.). Phys. Med. Biol.; 20: No. 5, 841-843(Sep 1975).

The British Committee on Radiation Units and Measurements (BCRU) has recommended the measurement of beta dose rates in air and has indicated factors for the conversion of these dose rates to dose rates in skin (BCRU, 1974, Phys. Med. Biol., 19, 748). These conversion factors were based on published measurements of $\beta$ radiation from the nuclides $^{90}Sr/^{90}Y$, $^{204}Tl$ and $^{147}Pm$ (Owen, B., 1973, Phys. Med. Biol., 18, 355). The value of the backscatter factor for $^{90}Sr/^{90}Y$ measured by Owen has been questioned (Pook, E. A., and Francis, T. M., Phys. Med. Biol., 20, 147), although the values of transmission factors for $^{90}Sr/^{90}Y$ and $^{204}Tl$ calculated from their data differ by less than 2% from the measured values given by Owen. The apparent discrepancy in backscatter factor may be due to a difference in transmission factor. The transmission factor is dependent on the experimental conditions and in particular on the geometry and nature of the radiation source. There are therefore unique values of the transmission factor for specific experimental conditions (e.g. the calibration of dosemeters). Since the transmission factor depends on the spectrum of $\beta$ radiation and hence on the thickness of absorber in front of the source, errors of 10 to 20% may be involved if single factors are assumed to apply to any given nuclide. Elimination of this error requires the development of dosemeters which, for $\beta$ radiation, enable the dose rate in the basal layer of the epidermis to be measured directly. (UK)

**12357** EVALUATION OF PATIENTS' EXPOSURE TO X RAYS DURING EXAMINATIONS OF THE UPPER PART OF THE GASTROINTESTINAL TRACT. Domanski, Z.; Marzecki, Z.; Stawarczyk, W. Wiad. Lek.; 28: No. 6, 439-443(1975). (In Polish).

The duration of examination and the dose of radiation were determined in 50 patients sent for radiological examinations of the upper part of the gastrointestinal tract. For determination of the dose of radiation to the skin the actual time of exposure was determined and the number of films was counted. The dose was calculated from the data obtained on a phantom. The duration of procedures ranged from 6 to 16 min., the dose from 26.1 to 53.7 R. The mean duration calculated for 50 cases was 10.3 min., while the joint dose of x radiation was 39.1 R. The greater part of the dose was received by the patients during exposure of the film. According to the authors the indications for radiological investigations of the upper part of the gastrointestinal tract are too broad and should be established with more caution. (auth)

**12358** EXPERIENCE IN IMPLEMENTING THE MARK III RAD 8 SYSTEM FOR RADIOTHERAPY DOSE COMPUTATIONS. Wilkinson, J. M.; Redmond, W. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Br. J. Radiol.; 48: No. 573, 732-738(Sep 1975).

Rad 8 is a small, in-house computer system for calculating radiotherapy dose distributions, both for multiple field and rotational external beam techniques and for interstitial and intracavitary radium treatments. Implementing the system has its difficulties, particularly in obtaining the necessary beam profile information. Several approaches have been tried and finally a separate profile generator program was written. Other difficulties encountered with beam data storage were overcome by making minor changes to the system programs. The various calculation techniques have been evaluated, and in general found to be satisfactory, and suitable factors to be used in the inhomogeneity correction for 4 MV x rays have been calculated based on previously published measured data. An option to change beam weightings exists and this can be used to renormalize dose distributions to give percentage isodose curves relative to the prescribed tumor dose. If this procedure is followed dose homogeneity over the target volume can readily be assessed, and the exposure times may easily be calculated from the new weightings. Certain shortcomings in the rotating beam program and the radium program may easily lead to error if extreme care is not exercised. (auth)

**12359** CARCINOGENESIS AND RADIATION RISK. A Biomathematical Reconnaissance. Mayneord, W. V. (Inst. of Cancer Research, Sutton, Eng.); Clarke, R. H. Br. J. Radiol.; No. Suppl. 12, 1-112(1975).

The biological effects of radiation are often correlated with the dose of radiation received by the tissue or cells at risk, although other physical factors such as spatial or temporal dose distributions, total number of cells irradiated, or relative biological effectiveness are also relevant. Biological experiments frequently reveal a complex relationship between effect and dose, rather than a simple proportionality. Certain of the consequences of taking into account such a complex relationship in assessing risk on the basis of dose have therefore been examined in detail, and the implications of different models or modes of carcinogenic action on the effects of different dose distributions in space or time are discussed. An extensive review of existing biological data has been carried out, and a mathematical formula developed in an attempt to define the risk under a variety of different irradiation conditions. The results are significant since estimates of the potential carcinogenic action of low doses and dose rates usually have to be made on the basis of existing evidence for exposure of human tissues at much higher doses and dose rates.

It is however emphasized that although mathematical formulation forces a clearer definition of the problems, the complexity of biological behavior defies mathematical analysis. (UK)

**12360** ANALYSIS OF TREATMENT IN CHILDHOOD LEUKEMIA. I. Predisposition to Methotrexate-Induced Neutropenia After Craniospinal Irradiation. MacLennan, I. C. W.; Kay, H. E. M.; Festenstein, M.; Smith, P. G. Br. Med. J.; 3: No. 5983, 563-566(6 Sep 1975).

The degree of drug-induced neutropenia resulting from a controlled trial (UKALL I) of treatment in acute lymphoblastic leukemia was analyzed. The main agent associated with severe neutropenia was methotrexate, and methotrexate-induced neutropenia was significantly greater in patients who had received craniospinal irradiation. The synergistic toxic effect of irradiation followed by methotrexate treatment seems to have contributed to three of the five deaths which occurred in complete remission in this trial; all deaths in remission occurred in patients who had received central nervous system prophylaxis. Analysis of patients who subsequently relapsed compared with those still in remission after 18 months of treatment indicated that the former, on average, had slightly lower neutrophil counts. This suggests that the children who relapsed did not receive any less aggressive treatment than those who remained in remission. (auth)

**12361** RADIATION BIOLOGY AND RADIATION THERAPY. Relevant Problems. Wideroee, R. (Eidgenoessische Technische Hochschule, Zurich). Fra Fys. Verden; 37: No. 2, 39-47(1975). (In Norwegian).

Radiation biology and radiation therapy can be compared with investigations in different layers of earth. Radiation biology works upwards from the elementary foundations, therapy works downwards with roots to secure and improve the clinical surface work. The Ellis formula (Strandquist), which is a collection of clinical experience, is suited to form connections with radiobiology in the middle layers, and cooperation can give impulses for research. The structure and conditions of tumors and the complicated problems met with are discussed, based on the Carmel symposium of 1969. The oxygen problem in anoxic tumors is not yet solved. Experimental investigations of the effect itself give partly contradictory results. From a clinical viewpoint reoxygenation is of the utmost significance for obtaining control over the primary tumor, advanced irradiation programs will here give better results than the traditional ones. New chemicals, e.g. $R_0$-07-0582, appear to reduce the OER value to 1.5, thereby making neutron therapy superfluous. Finally a problem from fundamental research is dealt with, wherein two hypotheses explaining the beta-effect are described. The repair hypothesis gives a simple explanation but leaves many questions unanswered. The other hypothesis explains the beta-effect as two neighboring single breaks of the DNA molecule. It still presents difficulties and is scarcely the correct explanation. (NO)

**12362** PRE-NATAL IRRADIATION AND CHILDHOOD MALIGNANCY. A Review of British Data from the Oxford Survey. Bithell, J. F.; Stewart, A. M. (Childhood Cancer Research Group, Oxford). Br. J. Cancer; 31: No. 3, 271-287(Mar 1975).

This paper reviews data relating to obstetric radiography from the Oxford Survey of Childhood Cancers, i.e., for deaths in Britian from 1953 to 1967. Some 8513 cases were traced and used in the analyses, together with an equal number of matched controls. The relative risk estimate (1.47 overall) does not vary significantly between different tumor groups, for different ages at death, nor between sexes. Other epidemiological factors—sibship position, maternal age, social class, region of residence, and maternal morbidity—were analyzed and showed varying degrees of association, but not sufficient to explain the observed risk in terms of a selection effect. The dependence of the risk on the number of films exposed was highly significant and adequately described by a linear relationship. The timing of and reason for the exposure were also examined. Analysis of the risk by year of birth showed a pattern of steadily declining risk for both solid and haematopoietic tumors; this may be partly attributable to lower radiation doses per film exposed but is also due to the smaller numbers of films used. A consequence may well be that the risk—always of small clinical significance—would become virtually undetectable in future investigations. (auth)

**12363** ELECTROPHORETIC DYNAMICS OF SYNOVIAL FLUID FOLLOWING $^{90}$Y YTTRIUM RADIATION SYNOVECTOMY. Hrncir, Z.; Kubicek, K.; Stastny, K.; Tichy, M.; Vavrina, J. Cas. Lek. Cesk.; 113: No. 21-22, 660-663(1974). (In Czech).

In 63 patients with chronic synovitis of the knee joint changes of the content of total protein and electrophoreogram of the synovial fluid were studied before and in the course of 3 months following radiation synovectomy by 5 mCi of Yttrium. Following the beginning of the fourth week statistically significant decrease in the content of alpha$_1$ and alpha$_2$ globulin fraction was found. According to the authors the study of these components of the protein spectrum contributes to quantitative evaluation of the therapeutic response to intraarticular $^{90}$Y Yttrium administration. (auth)

**12364** DOSIMETRIC MEANING OF HAEMATOLOGICAL DATA IN VICTIMS OF ACCIDENTAL IRRADIATION. Malarbet, J. L.; Le Go, R.; Prudhomme, J.; Genest, L. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Bull. Inf. Sci. Tech. (Paris); No. 203, 27-34(May 1975). (In French)

In the event of accidental irradiation the estimation of haematological damage situates the dose range. For serious irradiation the rapid perturbation and later change in the blood cell lines are good dose level indicators. In cases of relatively slight exposure the thrombocytes are the last blood cell elements to be seriously attached, with maximum depletion around the third week. (FR)

**12365** ANALYSIS OF INJURIES DUE TO IRRADIATION OF KELOIDS WITH ROENTGEN RAYS IN CHILDREN. Kik, A.; Bachurzewski, J.; Korniszewski, L. (Kliniki Dermatologicznej, Warsaw). Przegl. Dermatol.; 62: No. 1, 55-61(1975). (In Polish)

On the basis of many years' observations of 301 children with numerous keloids irradiated with x rays of whom 216 were treated with grenz rays, 62 with filtered Roentgen rays and 23 were treated by the indirect Gouin's method admissibility of roentgenotherapy in children is analyzed. It seems that at present filtered x rays may be replaced by other methods when small or medium-sized keloids are treated in children. In addition, the indirect Gouin's method should be confined to uncommonly extensive lesions with associated contractures. Although aimed pediatrical-endocrinological investigations failed to reveal any serious radiation injuries, except for 4 cases presented in detail, only grenz rays, aside from other equally valuable methods, should be used in the treatment of keloids in children. (auth)

**12366** DOSIMETRIC SIGNIFICANCE OF CYTOGENETIC EXAMINATIONS IN HUMAN ACCIDENTAL OVER EXPOSURES. Doloy-Biola, M. T.; Lego, R.; Ducatez, G.; Lepetit, J.; Bourguignon, M. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Bull. Inf. Sci. Tech. (Paris); No. 203, 17-25(May 1975). (In French)

The damage to 13 workers following accidental exposures was assessed from lymphocyte chromosomal aberrations, and the results compared with those supplied by physical dosimetry and the clinical syndromes. (FR)

**12367** SUBCLAVIAN ARTERY OCCLUSION FOLLOWING RADIOTHERAPY FOR CARCINOMA OF THE BREAST. Budin, J. A.; Casarella, W. J.; Harisiadis, L. (Coll. of Physicians and Surgeons, New York). Radiology; 118: No. 1, 169-173(Jan 1976).

Four cases of subclavian artery occlusion occurring 5 to 17 years after irradiation for breast carcinoma are presented. Although arterial insufficiency is a rarely reported sequel of radiotherapy, it may be the cause of pain and disability in the upper extremity in a postmastectomy patient. Particular attention should be paid to the presence of a bruit over the subclavian and axillary arteries. Arteriography will often reveal a short, segmental lesion of the subclavian artery that frequently can be repaired surgically. (auth)

**12368** PROSPECTS FOR X-RAY EXPOSURE REDUCTION USING RARE EARTH INTENSIFYING SCREENS. Wagner, R. F.; Weaver, K. E. (Bureau of Radiological Health, Rockville, MD). Radiology; 118: No. 1, 183-188(Jan 1976).

From measurements of screen-film sensitometry, Wiener spectra, and x-ray spectra, the speed, mottle, and quantum efficiency of several rare earth screen-film systems have been characterized. These systems offer exposure reductions of from two- to tenfold over conventional calcium tungstate systems. At the slower end, the noise (mottle) and resolution are comparable to what is available with conventional systems. Moreover, films designed to be used in such systems can be made with significantly lower silver content. As the speed advantage is increased from two- to tenfold, however, the mottle also increases. (auth)

**12369** STUDIES OF GRANULOCYTE KINETICS IN NORMAL AND GRANULOCYTOPENIC SUBJECTS. Dresch, C.; Faille, A.; Bauchet, J.; Najean, Y. (Hopital Saint-Louis, 75- Paris (France)). Biomedicine; 22: No. 2, 145-157(Mar 1975).

Granulopoiesis was studied simultaneously by three methods in normal subjects and in subjects with neutropenia of various etiologies: in vitro labeling of autologous and homologous granulocytes for the study of peripheral kinetics, in vivo labeling with DF$^{32}$P (di-isopropyl-fluorophosphate $^{32}$P) or $^{75}$Se-selenomethionine, and bone marrow autoradiography after in vitro labeling with $^{3}$H-thymidine for the study of bone marrow granulopoiesis. Three

main mechanisms of neutropenia can be distinguished: peripheral hyperdestruction, corpuscular or extra-corpuscular, and false leukopenias (change in the distribution of peripheral granulocytes from the circulating to the marginal granulocyte pool); quantitative bone marrow insufficiency without qualitative abnormality; qualitative abnormality in bone marrow granulopoiesis with cell death in either the maturation stage or the proliferative stage. There is no exact correlation between clinical and kinetic classifications, but most cases of post infection chronic neutropenias and idiopathic neutropenias fall into the first two categories, and most cases of benzol intoxication and bone marrow insufficiency due to irradiation fall into the last category. Some of these last patients developed an acute myeloblastic leukaemia in the two following years and can be considered as preleukaemic states. (FR)

**12370** RADIATIONS AND LIVING BEINGS. Schaeffer, R. Radioprotection; 9: No. 4, 289-305(1974). (In French).

Extract from Cah. Ing. Agron., Mar. 1974 (No. 284).

The biological effects of radiation were studied in irradiated individuals and their offspring. In irradiated individuals, the dose-effect relationship is linear only at very high dose rates corresponding to saturated recovery processes. At other dose rates, the relationship is described by a sigmoid deviating from linearity as the exposure duration is longer. The transition from a straight line to a sigmoid is expressed by mathematical formulas that show that continuous exposure of populations at the maximum permissible dose rate of 500 mrem/y to the whole body (gonads excluded) should induce less than one leukemia per year in the world. The study of the effects on the offspring of irradiated individuals was based on the extrapolation of experimental results obtained with animals belonging to species at various evolution levels. Among the less evoluted species, insects are highly resistant to instantaneous exposure of several hundred thousand rems, but exposure of successive generations results in a progressive cumulation of mutated genes of chromosome aberrations, as shown by the appearance of still higher ratio of damages in the offspring. Conversely, at a higher degree of evolution, mice are less resistant to instantaneous exposure but the cumulation is much less apparent. This could be explained by the minimum number of mutated genes whose combined action is required to reveal the damage. Without assuming any threshold to the action of radiation, it is demonstrated that there must occur practically no damage provided the present radiation protection standards are respected. (FR)

**12371** RATIONALIZED COMPUTATION OF DOSE DISTRIBUTION IN TELECURIETHERAPY. II. Pendulum Therapy. Matula, P.; Futas, E.; Klvana, M.; Kunstadt, E. (Univerzita P. J. Safarika, Kosice (Czechoslovakia). Lekarska Fakulta). Cesk. Radiol.; 28: No. 5, 336-342(Sep 1974). (In Slovak).

The principle is presented of the dose distribution calculation based on the concept of a constant source-to-sensor distance, which takes into account the effect of variations in the pendulum technique geometric and physical parameters. An analysis is also made of the effect of changes in the patients' silhouettes. The possibilities of standardizing the dose calculations are discussed. (auth)

**12372** EXPERIMENTAL AND CLINICAL CONSIDERATIONS CONCERNING THE RADIOTHERAPEUTICAL EXPLOITATION OF THE CRABTREE EFFECT IN RADIOTHERAPY. Mustea, I. (Oncological Institute, Cluj (Romania)). Neoplasma; 21: No. 5, 525-536(1974).

69 refs.

The conditions in which the Crabtree effect produces the most enhanced response of Ehrlich ascites tumor cells to radiation in vivo were studied. The redox state modification as well as the incorporation of $^{3}H$-thymidine in cells during the Crabtree effect were also investigated. The results showed that, both for glucose and glucose + insulin, the response to radiation depended on the interval between the drug administration and the irradiation. The lowest rH values were found for intervals corresponding to maximum enhancement effects. After irradiations with doses within a range of 250 to 1000 R the enhancement effect was only observed for a dose of 1000 R. The Crabtree effect was determined in 59 surgically removed primary human tumors and metastases. Most primary tumors displayed the effect, whereas this was less evident or absent in metastases. (auth)

**12373** RADIATION-INDUCED PSEUDOARTHROSIS. Kolar, J.; Bek, V.; Vrabec, R. (Karlova Universita, Prague (Czechoslovakia). Fakulta Vseobecneho Lekarstvi); Jakoubkova, J.; Suna, Z. (Karlova Universita, Prague (Czechoslovakia). Lekarska Fakulta Hygienicka). Cesk. Radiol.; 28: No. 6, 377-384(Nov 1974). (In Czech).

Radiation-induced pseudoarthrosis still remains one of the possible complications of radiation therapy particularly in the case of a malignant neoplasm. The prognosis improved substantially with the aid of active surgical approach, supported by antibiotics. The number of inflammatory complications decreased substantially and the success of surgical treatment in nearly one third of 37 patients reported here shows that surgical approach remains a method of choice. In addition to several radiographic pictures a case of pseudoarthrosis in hypoplastic scaphoid hitherto not reported in medical literature is documented more extensively. (auth)

**12374** CLINICAL EXAMINATIONS ON THE IMPORTANCE OF DIFFERENT FRACTIONATION RHYTHMS FOR RADIATION THERAPY. Radiation Physical Model Representations for Optimization of Fractionation Conditions in Radiation Therapy. Kriester, A. (Friedrich-Schiller Univ., Jena, Ger.). Radiobiol. Radiother.; 16: No. 4, 419-423(1975). (In German)

Following the estimation of usability and limits of the NSD-conception which at present is thought to be the most practicable basis of fractionation, radiation biophysical model is represented, without mathematical formulations. This model allows for tumour and normal tissue of different primary radiosensitivity and proliferative capacity under consideration of short-time and long-time recovery effects to estimate the electivity (ratio of surviving normal to tumour cells) and the effectiveness of fractionated irradiation. Lower single doses (with high total dose) and smaller intervals of irradiation are indicated for radioresistant tumours of low proliferative rate, whereas optimum success of treatment can be expected by somewhat higher single doses applied at longer intervals for tumours with higher radiosensitivity. Extremely high or low single doses proved to be unsuitable in all cases. (auth)

**12375** CLINICAL STUDIES ON THE SIGNIFICANCE OF DIFFERENT RHYTHMS OF FRACTIONATION FOR RADIOTHERAPY. Notter, G.; Ragnhult, I.; Turesson, I. (Univ., Goteborg). Radiobiol. Radiother.; 16: No. 4, 425-435(1975). (In German)

Equations are presented to show the development of the CRE (cumulative radiation effect) formula. The use of various radiation doses and fractionation schemes for a number of cancer patients is described. The destruction of oxygen-saturated tumor cells by high initial doses with certain fractionation schemes is discussed. The validity of the CRE formula was investigated for various treatment times and volume sizes. It is believed that prospective calculation of cumulative radiation effects can be used with benefit for clinical dose planning. (HLW)

**12376** HISTOLOGICALLY CONTROLLED EXAMINATIONS ON THE EFFECT OF DIFFERENT FRACTIONATION RHYTHMS FOR THE IRRADIATION OF BRONCHIAL CARCINOMA. Eichhorn, H. J.; Lessel, A. Radiobiol. Radiother.; 16: No. 4, 437-441(1975). (In German)

The effect of a highly fractionated radiation therapy is compared to a little fractionated one on patients with bronchial carcinoma in 3 experimental series with smaller tumours (preoperative irradiation) and 6 experimental series with larger tumours (inoperable cases). Comparison standard was the histological examination of operational and autoptic preparations, respectively, for complete tumour annihilation. The comparability of the experimental series was carefully statistically analyzed (distribution of mature and immature tumour types, total dose, tumour volume, time of irradiation). The comparison revealed that as well in the preoperatively irradiated series as in the inoperable series those with daily fractionation showed a higher quota of tumour annihilation than those being irradiated with higher single doses and pauses of several days. This different effect which could be statistically ascertained in those receiving 1 to 3 high initial doses. This result contradicting the radiobiological experiments on cell cultures and animal tumours is interpreted by distribution of radioresistant and radiosensitive cyclic phases of human tumour cells in vivo having a much slower cyclic course than in vitro. (auth)

**12377** IMPORTANCE OF FRACTIONATION AND SERIAL PAUSES FOR THE PROPHYLAXIS OF LATE RADIATION DAMAGES. Fuchs, G. (Internationales Institut fuer den Frieden, Vienna). Radiobiol. Radiother.; 16: No. 4, 451-455(1975). (In German)

A short survey of the biological principles of fractionated radiation therapy is given. The concept of fractionation should not only cover the separate irradiations within a series but also the total radiation therapy and the serial pauses. According to the author's experiences late damages can be prevented by distributing the dose to several series separated by pauses lasting for months. Furthermore, the author's experiences have shown that there is scarcely the risk of malignant late damages developing after radiation therapy. (auth)

**12378** CLINICAL EXPERIENCES WITH INTRACAVITARY GAMMA-RAY THERAPY OF CERVIX CARCINOMA WITH AFTER-

LOADING APPARATUS "AGAT-V". Kostromina, K. N. (Zentralinstituts fuer Aerztliche Fortbildung, Moscow). Radiobiol. Radiother.; 16: No. 4, 457-466(1975). (In German)

The clinical observations of 194 patients with cervix carcinoma were analyzed. These patients had been treated with intracavitary gamma-ray therapy according to the principle of remote afterloading with the apparatus Agat-V. Medical indications, peculiarities and problems of fractionation are discussed for this method of treatment. The therapeutic results in an observation period of 4 to 5 years (48 patients out of 61 are alive) point to a fairly high clinical effectiveness of this method. (auth)

**12379** NATIONAL ARRANGEMENTS FOR INCIDENTS INVOLVING RADIOACTIVITY (NAIR). Wray, E. T. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 13, 4-9(Oct 1975).

Incidents such as accidents during the transport of radioactive materials, and also the recovery by members of the public of lost radioactive sources, have demonstrated the need for expert advice and help to be available to bodies such as the police. A description is given of the organization and operation of such a scheme (NAIR) which has covered the whole of Great Britain since 1964. The National Radiological Protection Board (NRPB) is now responsible for the coordination of this scheme. The 138 calls for assistance to NAIR since 1964 are surveyed and analyzed. Almost 34% of the incidents did not involve any radioactive material at all. The satisfactory nature, even under very adverse conditions, of the design and manufacture of Types A and B transport packages is demonstrated. The type of transport accident involving most inconvenience, but probably only minor hazard, was that involving low specific activity materials in powder or particulate form, where packaging was of an industrial type. In the category of radioactive sources, those used in industrial radiographic equipment probably offer the greatest potential hazards. The survey demonstrated that NAIR operates quickly and efficiently when correctly implemented. Training courses for experts are already in operation, and the NRPB hopes to extend these to those who may have to decide whether a radioactive incident has occurred or not. (UK)

**12380** SREDSTVA INDIVIDUAL'NOI ZASHCHITY DLYA RABOT S RADIOAKTIVNYMI VESHCHESTVAMI. (Means of Personnel Protection for Working with Radioactive Substances). Gorodinskii, S. M. Moscow; Atomizdat (1973). 295p.

The book discusses the main theoretical and practical problems of personnel protection in working with radioactive substances. A description is given of the principal means used to protect the respiratory organs and skin, which have been utilized under various production conditions in working with radioactive materials. The author generalizes his longterm experience in research and construction work in the field of personnel protection. Great attention in the book is devoted to methods of estimating body burdens, to confirming the protective efficiency, and to the correct use and decontamination of personnel protective equipment. (tr-auth)

**12381** EPA REQUIREMENTS FOR THE URANIUM FUEL CYCLE. Dunster, H. J. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 13, 10-11(Oct 1975).

The draft Environmental Statement issued by the Environmental Protection Agency (EPA) in the United States in preparation for proposed rulemaking action concerning environmental radiation protection requirements for normal operations of activities in the uranium fuel cycle is summarized and discussed. The standards proposed by the EPA limit the annual dose equivalents to any member of the public, and also the releases of radionuclides to the "general environment" for each gigawatt year of electrical energy produced. These standards were based on cost effectiveness arguments and levels and correspond to the ICRP recommendation to keep all exposures as low as reasonably achievable, economic and social factors being taken into account. They should be clearly distinguished from dose limits, although the EPA does not make this at all clear. The EPA seems to have shown an unexpected lack of understanding of the recommendations of ICRP Publication 9 (1965) and an apparent unawareness of ICRP Publication 22 (1973), and has therefore wrongly presented the new standards as a significant change in policy. The EPA has reviewed the information on the likely level of dose equivalents to members of the public and the likely cost reductions, thereby quantifying existing principles as applied to the fuel cycle as a whole. The EPA has stated that its proposals could be achieved at a cost in the region of $100,000 per death (or major genetic defect). It is pointed out that the EPA's use of the term waste to exclude liquid and gaseous effluents may cause confusion. (UK)

**12382** RADIATION INDUCED LEUKEMIA IN MAN. Modan, B.; Lubin, E. (Tel Aviv Univ., Israel). Ser. Haematol. (Copenhagen); 7: No. 2, 192-210(1974).

The role of ionizing irradiation in the etiology of human leukemia has been extensively revised with emphasis on (a) irradiation dose, rate, and quality (b) individual susceptibility (c) consistency of methodology of estimating leukemia risk in human population studies. 111 references have been summarized. (DA)

**12383** REVISED BORON-NEUTRON CAPTURE THERAPY FOR MALIGNANT BRAIN TUMORS. I. Experience on Terminally Ill Patients After $^{60}$Co Radiotherapy. Hatanaka, H.; Sano, K. (Teikyo University Hospital, Tokyo). J. Neurol.; 204: No. 4, 309-332(1973).

Boron-neutron capture therapy based on the nuclear reaction between low energy neutron and non-radioactive isotope Boron-10 which produces short-range $\alpha$-particle has been performed since 1968. Improved boron compounds, radiation schedule, and technique enabled extension of life span of terminal stage glioblastoma patients who had been pre-treated by Cobalt-60 or enabled the full-scale social activity in other patients. (auth)

**12384** VISUAL SENSATIONS INDUCED BY CHERENKOV RADIATION. McNulty, P. J. (Clarkson Coll. of Technology, Potsdam, NY); Pease, V. P.; Bond, V. P. Science; 189: No. 4201, 453-454(8 Aug 1975).

Pulses of relativistic singly charged particles entering the eyeball induce a variety of visual phenomena by means of Cerenkov radiation generated during their passage through the vitreous. These phenomena are similar in appearance to many of the visual sensations experienced by Apollo astronauts exposed to the cosmic rays in deep space. (auth)

## Vertebrates

*Refer also to abstracts 12206, 12253, and 12255.*

**12385** (CONF-751037-1) SPERMATOGONIAL STEM CELL RENEWAL IN THE MOUSE AS REVEALED BY $^{3}$H-THYMIDINE LABELING AND IRRADIATION. Oakberg, E. F.; Huckins, C. (Oak Ridge National Lab., Tenn. (USA); Baylor Univ., Houston, Tex. (USA). Coll. of Medicine). 1975. 27p. Dep. NTIS $4.50.

From symposium on stem cells; Montreal, Canada (8 Oct 1975).

Procedures are described for sectioning and staining mouse testes, x-irradiation of mice, and classification of developing sperm cells. Tables are presented to show frequency of labeled cells following exposure to various doses of x radiation. A discussion is presented of types of spermatogonia surviving various radiation doses and times of incorporation of $^{3}$H-TdR in the cycle of the seminiferous epithelium. Models of stem cell renewal systems are described. (HLW)

**12386** (COO-1748-15) NEUTRON-INDUCED MUTATION EXPERIMENTS. Progress Report, March 1, 1975–February 29, 1976. Abrahamson, S. (Wisconsin Univ., Madison (USA)). Nov 1975. Contract E(11-1)-1748. 24p. Dep. NTIS $3.50.

The relative mutagenic effectiveness of neutrons of different energies were compared with x radiation in mice and Drosophila oogonia employing X-linked recessive lethal and specific locus mutation tests. The energies and doses used were 0.68 MeV, 2 MeV, and 6 MeV (250 and 500 $^{0}$R), and 15 MeV (250, 500, and 1000 $^{0}$R). The data thus far collected from the recessive lethal test indicate that 0.68 MeV neutrons have the highest RBE among the energies tested, followed by 6 and 2 MeV. The specific locus mutation data also indicate the highest RBE for 0.68 MeV, followed respectively by 2 and 6 MeV. The 15 MeV data is as of now incompletely analyzed, as are some dose points of 2 and 6 MeV. (auth)

**12387** (COO-2368-18) EIGHTEENTH YEAR PROGRESS REPORT, JULY 1, 1974–JUNE 31, 1975. (Jefferson Medical Coll., Philadelphia, Pa. (USA)). 1975. Contract E(11-1)-3268. 36p. Dep. NTIS $5.00.

Progress is reported for studies on the effects of embryonic x irradiation at doses of 50 or 100 R on the lifespan and incidence of leukemia in adult mice and rats. The effects of three 100 R doses on the first day of gestation on cell death in the embryos were also studied. (CH)

**12388** (INIS-mf-1622) PROTECTIVE EFFECT OF A VITAMINIC-LIPOTROPIC CONCENTRATE IN GAMMA-IRRADIATED RATS. Markova, M. (Ministerstvo na Narodnoto Zdrave, Sofia (Bulgaria); Meditsinska Akademiya, Sofia (Bulgaria); Nauchno Druzhestvo na Rentgenolozite i Radiolozite, Sofia (Bulgaria). Sektsiya po Radiologiya). 1973. 10p. (In Bulgarian). (CONF-731168-6). INIS.

From 3rd national conference on radiology and radiobiology; Plovdiv, Bulgaria (1 Nov 1973).

Experimental studies were carried out on albino rats fed a diet containing vitaminic-lipotropic concentrate and receiving single 12-minute exposures to 500 rad from a gammatron. The concentrate included the following biologically active substances:

vitamins, lipotropic compounds, and roborants. It was given in granulate form dissolved in water over the period from one month pre- to one month post-irradiation. The results obtained clearly indicated a significant effect (compared to the group given no concentrate) on the following parameters: residual nitrogen, intrinsic glucose, peripheral leukocyte formula, total nitrogen, lipids and glycogen in liver, as well as general condition of the organism. In conclusion, the effect in irradiated animals being decidedly beneficial, it is suggested that the concentrate be tested in radiation workers. (auth)

**12389** (LBL-4250) DOSIMETRY FOR RADIOBIOLOGICAL EXPERIMENTS USING ENERGETIC HEAVY IONS. Smith, A. R.; Stephens, L. D.; Thomas, R. H. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 30 Aug 1975. Contract W-7405-Eng-48. 35p. (CONF-750707-7). Dep. NTIS $4.00.

From annual meeting of the Health Physics Society; Buffalo, New York, USA (12 Jul 1975).

The availability of the Bevalac facility of energetic heavy ions with range greater than the size of small mammals makes possible the determination of the biological effects of relatively well defined high LET, whole body irradiation. With the increasing application of high-energy heavy ions in radiobiology there is a corresponding need to develop reliable techniques of both relative and absolute absorbed dose measurement. This paper describes dosimetry studies by the Health Physics Department of the Lawrence Berkeley Laboratory with activation detectors, ionization chambers, nuclear emulsion, thermoluminescent dosimeters and X-ray film. The application of these techniques to an experiment designed to study the leukemogenic effect of the whole-body irradiation of mice by 250 MeV/amu carbon ions is briefly described. Values of absorbed dose in tissue, obtained during this experiment, with a nitrogen filled ionization chamber and $^{7}$LiF thermoluminescent dosimeters are compared and shown to be in good agreement. As a result of this work a value for the average energy to produce an ion pair (W) in nitrogen by 250 MeV/amu $^{12}$C ions of 37 + - eV was determined. Values of the efficiency of $^{7}$LiF relative to $^{60}$Co gamma-rays for ions with dE/dx in the range 110-260 MeV $g^{-1}$ $cm^2$ are reported. (auth)

**12390** (N-75-16213) LYMPHOID CELL KINETICS UNDER CONTINUOUS LOW DOSE-RATE GAMMA IRRADIATION: A COMPARISON STUDY. Semiannual Status Report. Foster, B. R. (Grambling State Univ., La. (USA). Dept. of Physics). 12 Feb 1975. 15p. (NASA-CR-142068). NTIS $3.25.

The mechanism of cell proliferation is studied in the lymphoid tissue of the mouse spleen under the stress of continuous irradiation at a dose-rate of 10 roentgens per day for 105 days. Autoradiography and specific labeling with tritiated thymidine were utilized. It was found that at least four compensatory mechanisms maintained a near-steady state of cellular growth: (1) an increase in the proportion of PAS-positive cells which stimulate mitotic activity, (2) maturation arrest of proliferating and differentiating cells which tend to replenish the cells damaged or destroyed by irradiation, and (3) an increase in the proportion of cells proliferating, and (4) an increase in the proportion of precursor cells. The results are compared to previous findings observed in the thymus. (STAR)

**12391** IMMUNOLOGICAL REACTIVATION OF IRRADIATED MICE BY MEANS OF SYNGENEIC CELL TRANSFER. Schaeffner, H.; Neumeister, K. (Karl-Marx-Universitaet, Leipzig). Allerg. Immunol.; 19: No. 2-4, 178-184(1973). (In German).

Sublethally irradiated CBA mice react very weak against SRBCs. The number of spleen PFCs is not greater as the background of nonimmunized animals until the 8th day after immunization. The transfer of $30 \times 10^6$ normal syngenous spleen cells in a 10 percent SRBC suspension increases the immune response from the 2nd to the 8th day after the irradiation, cell transfer, and immunization. A booster injection 4 days after the sensitization provokes a strong immune response even 2 days later. It is shown, that only the number of IgM plaques increases, the IgG PFCs are not affected by the booster injection. It is discussed that in irradiated recipients the suppressive effect of humoral IgG antibodies on the differentiation of IgM precursors is absent. (auth)

**12392** DEVELOPMENT OF THE RAT SEMINIFEROUS TUBULES FOLLOWING PREPUBERTAL WHOLE-BODY X-IRRADIATION. Hovatta, O.; Kormano, M. (Univ. of Helsinki). Andrologia; 6: No. 3, 277-285(1974).

In the present study x-irradiation damage of the prepubertal spermatogenic epithelium was induced in rats and the development of the contractility was studied in relation to the histologically observed regression and regeneration of the seminiferous epithelium. (auth)

**12393** COMPARATIVE CHARACTERISTICS OF THE EFFECT OF X RAYS AND THIOPHOSPHAMIDE ON THE CONTENT OF ZINC AND ACTIVITY OF CARBANHYDRASE. Savitskii, I. V. Mikroelem. Med.; No. 5, 51-54(1974). (In Russian).

When rats were subjected to general irradiation (Ob) at a dose of 450 R or subjected to thiophosphamide (I) at a dose of 6 mg/kg, a two-sided alteration of the content of Zn in tissues was noted, depending on the organ and the time of the development of radiation effect. After Ob in all tissues (except for blood) the concentration of Zn was lowered after 6 hrs and 1 day, later (3 to 15 days) it became elevated. The type of the Zn concentration changes in the organs after administration of I resembles the effect of Ob, especially in liver, kidneys, and muscles. The activity of blood carbanhydrase became lower at the 3rd day after I or Ob and at the 7th and 15th day became somewhat normalized in the case of Ob, but was still low in rabbits getting I. (JPRS)

**12394** EFFECT OF IRRADIATION ON IMMUNE CELL-MEDIATED CYTOLYSIS OF TUMOR CELLS. Kim, T.; Song, C. W.; Levitt, S. H. (Univ. of Minnesota, Minneapolis). Eur. J. Cancer; 11: No. 8, 589-591(Aug 1975).

The study reported was undertaken to investigate the combined effect of radiation and cell-mediated immune reaction under situations similar to clinical radiotherapy. A mixture of $^{125}$I-labelled ascites tumor cells of mice and immune lymphocytes were irradiated with 250 rad of x rays and the destruction of tumor cells studied in vitro. It was found that the effect of immune lymphocytes plus x irradiation was at least additive in causing damage to the tumor. (UK)

**12395** LETHAL AND SUBLETHAL CELLULAR INJURY IN MULTIFRACTION IRRADIATION. Withers, H. R. (Anderson Hospital and Tumor Inst., Houston, TX). Eur. J. Cancer; 11: No. 8, 581-583(Aug 1975).

Work has been carried out on cellular injury in multifraction irradiation of mouse tissues and compared with similar work on human skin reported earlier by Dutreix et al (Eur. J. Cancer.; 9: 159 (1973)). In agreement with Dutreix et al it is emphasized that the absolute amount of sublethal injury repaired per fractionation interval ($D_r$) is not as important to radiotherapists as the change in the amount repaired ($\Delta D_r$) when the dose-per-fraction is altered. It was found that although there is a critical divergence at low doses, the data for mouse tissues are similar to those previously given for human skin and support the conclusions: (i) That the capacity of many normal cells for accumulating and repairing sublethal radiation injury is probably not greatly different. (ii) That fixed exponents used for fraction number and time in iso-effect formulae are inappropriate. At low doses-per-fraction, repair of sublethal injury is complete, or nearly so, and hence, additional fractionation of dose does not give appreciable additional sparing, whereas rapidly-regenerating tissues, due to the lengthening of overall time, would continue being spared by repopulation. (UK)

**12396** ENHANCEMENT OF SYNGENEIC MURINE TUMOR TRANSPLANTABILITY BY WHOLE-BODY IRRADIATION. A Non-immunological Phenomenon. Peters, L. J. (Mount Vernon Hospital, Northwood, Eng.). Br. J. Cancer; 31: No. 3, 293-300 (Mar 1975).

Experiments were undertaken to test the general validity of the assumption that potentiation of tumor transplantability by sublethal whole body irradiation (WBI) implies some degree of immunological resistance in the intact host. A transplantable carcinoma of spontaneous origin in CBA mice which exhibits a large WBI effect was assayed quantitatively in mice which had been immunologically crippled in terms of allograft acceptance by depletion of thymus derived lymphocytes. The mean number of tumor cells required for 50% successful takes ($TD_{50}$) in these mice was found to be not significantly different from that in normal controls but highly significantly greater than in WBI mice. On the other hand, in mice which underwent laparotomy immediately before assay, the $TD_{50}$ was reduced significantly though not to the same extent as in WBI mice. It was concluded that WBI effect was not due to impaired host immunity but possibly to physiological changes resulting from acute stress. The hypothesis that hyperfibrinogenaemia which occurs after both WBI and laparotomy might increase tumor transplantability was rejected because of the lack of correlation between $TD_{50}$ and fibrinogen levels at different times after each procedure. From this and other work it is apparent that $TD_{50}$ data, in themselves, give no reliable indication of host immunity. (auth)

**12397** DECREASED INCIDENCE OF RETICULUM CELL SARCOMA IN WHOLE-BODY IRRADIATION AND BONE MARROW SHIELDED MICE. Covelli, V.; Metalli, P.; Bassani, B. (CNEN, Casaccia, Italy). Br. J. Cancer; 31: No. 3, 369-371(Mar 1975).

Reticulum cell sarcoma (RCS) is observed with an average final incidence of about 57% and appears late in the life of untreated ageing (C57B1/Cne X C3H/Cne) F1 male mice (Covelli

et al., 1973, Tumori, 59, 97). Previous experiments had demonstrated that the frequency of RCS could be reduced to about 1 to 3% if the young adult animals were given whole-body irradiation and injected intravenously with viable bone marrow cells from isogeneic donors (Covelli et al., 1974, Int. J. Radiat. Biol., 26, 1). Anaesthetized mice were irradiated with just one hind leg inserted in a lead tube to shield some of the bone marrow, so that repopulation of the whole haemopoietic system could start from the intact marrow left in situ. All the animals were followed until spontaneous death. The results showed that the unirradiated bone marrow, left in its natural site, was as effective in depressing the late appearance of RCS as the marrow cell suspensions from isogeneic donors injected in whole-body irradiated animals. The possibility that the standard laboratory technique of flushing out single cell suspensions of marrow cells from the diaphyses of long bones of rodents might reduce either the proportion or viability of the reticular components is therefore eliminated. The conclusion that the bone marrow cells of normal young adult mice of this strain, and their lifetime descendants in syngeneic marrow transplanted irradiated animals, have an extremely small probability of spontaneous neoplastic transformation to reticular tumors is therefore substantiated. (UK)

**12398** REPAIR OF RADIATION DAMAGE TO CAPILLARY ENDOTHELIUM. Reinhold, H. S. (Gezondheidsorganisatie TNO, Rijswijk, Netherlands); Buisman, G. H. Br. J. Radiol.; 48: No. 573, 727-731(Sep 1975).

Two types of repair occurring in capillary endothelium after irradiation were investigated. The system used was the rat subcutis air-pouch, in which the capillary endothelium was stimulated to proliferate by a combined mechanical and chemical stimulus. Assay was by an angiographic technique. The system allowed temporal separation between the moment of irradiation and the moment of stimulation to proliferation. The results indicated that capillary endothelium shows the typical Elkind-type of time-recovery curve. When the stimulus to proliferation after a single dose of x rays was delayed, however, the $D_0$ value rose from 168 rads (immediate stimulation) to 273 rads (stimulation to proliferation delayed for 32 days). The conclusion could therefore be made that many more endothelial cells survive in the tissues after radiotherapy than one would have inferred from the simple direct proliferation assays. (auth)

**12399** MEASUREMENT OF ERYTHROPOIESIS BY RADIO-IRON INCORPORATION: INFLUENCE OF IRON AND CELL KINETIC CHANGES. Schofield, R. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Exp. Hematol.; 3: 22-25 (1975).

Iron-59 blood appearance curves have been obtained in mice by injection of the isotope at various times after 850 rad whole-body x irradiation and bone marrow grafting in order to produce different levels of erythropoiesis. The results demonstrate that measurements at 24, 48, and 72 hours are not comparable and lead to different interpretations. Standardization of the time at which $^{59}Fe$ uptake measurements are made is therefore recommended. (DA)

**12400** RESTORATIVE EFFECT OF ERYTHROPOIETIC STIMULATION UPON THE SUBLETHALLY IRRADIATED (SLI) HEMATOPOIETIC STEM CELL AND/OR ITS PROGENY. Wolf, N. S. (Washington Univ., Seattle); Trentin, J. J. Exp. Hematol.; 3: 57-64(1975).

Bone marrow cells from sublethally irradiated donor mice injected into supralethally (1000 R) irradiated recipients produced not only many fewer spleen colonies but fewer erythrocytic (E) colonies in relation to the number of granulocytic (G) colonies than did unirradiated donor marrow in similar recipients. This reversal of E : G ratio was partially or completely restored by a strong erythropoietic stimulus in the recipients, whether endogenous, (induced by anemia) or exogenous (injected purified EP). Such a stimulus produced a large increase in total spleen colony numbers in all experiments. An unexpected result was a major increase in granulocytic and megakaryocytic colonies in the spleen and marrow of the erythropoietically stimulated recipients. It was concluded that the sublethal irradiation to the donor either produced or revealed a subpopulation of potential colony forming cells whose cell cycle was slow or temporarily arrested. The added EP (and/or related substances) was proposed to have either overridden or induced repair of a radiation defect, or stimulated a small and normally undetectable population requiring high levels of stimulant to induce cycling. The result was the expression of their progeny as colonies, whose differentiative type depended upon the kind of hematopoietic inducing microenvironment in which they had lodged. (DA)

**12401** TREATMENT OF CANINE MALIGNANCIES BY 1200 R TOTAL-BODY IRRADIATION AND AUTOLOGOUS MARROW GRAFTS. Weiden, P. L.; Storb, R.; Lerner, K. G.; Kao, G. F.; Graham, T. C.; Thomas, E. D. (Washington Univ., Seattle). Exp. Hematol.; 3: 124-134(1975).

Twenty-five dogs with malignant lymphoma (L) and 18 dogs with solid, nonhematologic tumors (ST) were treated with 1200 R total-body irradiation (TBI). Rescue from the otherwise lethal hemopoietic toxicity by infusion of autologous marrow aspirated before TBI was attempted, and survival, response to TBI, and immune reactivity post-grafting were determined. Eight L dogs survived more than 14 days post TBI and marrow grafting, and 12 out of 19 evaluable dogs showed a decrease of 75 per cent or more in clinically detectable tumor. There was no evident relationship between clinical status or marrow status before TBI and survival of more than 14 days or tumor response to TBI. Seven of the 8 survivors ultimately developed recurrent tumor. Eight ST dogs survived more than 14 days. Only 4 of 14 evaluable ST dogs showed significant clinical response of their tumor to TBI. Humoral and cellular immune reactivity were significantly impaired during the 10-week period following TBI and marrow grafting in all dogs studied. These results indicate that therapy in addition to lethal doses of TBI is necessary to cure spontaneous L or to significantly affect ST in dogs. They also provide baseline data which are necessary to assess the immunotherapeutic effectiveness of allogeneic marrow grafts. (DA)

**12402** SOME HYPOTHESES CONCERNING THE MECHANISM OF ACTION OF EXOGENOUS ANIMAL DNA ON MAMMALS. Kalbarczyk, S. Postepy Biochem.; 19: 247-260(1973). (In Polish).

The following hypotheses are discussed: (1) extraintestinally introduced DNA is utilized as a matrix; (2) its fragments are used for repairing the damaged recipient DNA; (3) fragments of the administered biopolymer disturb the replication by indegrating with endogenous DNA; (4) micromolecular products of disintegration of oxogenous DNA stimulate the synthesis of acceptor DNA; (5) the administered biopolymer acts as a protecting agent; (6) exogenous DNA, by reacting with histones or other inhibitors of matrix activity of recipient DNA favours the derepression of the latter. (auth)

**12403** ACTION OF ANTILYMPHOCYTIC SERUM IN VIVO AND IN VITRO ON ALLOGENOUS HEMOPOIETIC CELLS TRANSPLANTED TO IRRADIATED DOGS. Novikova, M. N.; Lemeneva, L. N.; Udalov, G. A.; Chertkov, I. L. (Central Inst. of Hematology and Transfusion, Moscow). Probl. Gematol. Pereliv. Krovi; 19: No. 11, 55-58(Nov 1974). (In Russian).

A study was made of a possibility of using antilymphocytic serum (ALS) to prevent lymphoid differentiation of transplanted allogenous bone marrow cells in the lethally irradiated dogs. Administration of ALS to a donor failed to decrease the capacity of the transplanted bone marrow to produce acute secondary disease. In vitro ALS produced a cytotoxic action on the stem hemopoietic cells. ALS administered to the recipients in a dose of 0.1 to 0.2 ml per kg of body weight (once or repeatedly) partially prevented immune transformation of hemopoiesis. (auth)

**12404** COMBINED EFFECTS OF A CHEMICAL MUTAGEN AND RADIATION STERILIZED DIED IN MUTAGENICITY AND REPRODUCTION STUDIES IN THE SAME MOUSE. Renner, H. W. (Inst. fuer Strahlentechnologie, Karlsruhe, Ger.). Food Cosmet. Toxicol.; 13: No. 4, 427-431(Aug 1975). (In German).

The possible intensification of the mutagenic effect of cyclophosphamide (Endoxan) by the feeding of a radiation-sterilized diet (dose, 4.5 Mrad) was studied in 2000 NMRI/Han mice. In a dominant lethal test, males were pretreated with 100 mg Endoxan/kg body weight. The greatest sensitivity towards Endoxan was observed during the late-spermatid stage. No significant differences were detected between the control group (Endoxan plus non-irradiated diet) and the experimental group (Endoxan plus radiation-sterilized diet). In this test, radiation-sterilized feed showed no co-mutagenic effect when combined with Endoxan treatment. In a reproduction study of 7 months duration (continuous mating without lactation periods), the females were treated every 2 wk with 20 mg Endoxan/kg body weight. The decline in litter size with increasing number of litters (i.e., with advancing age of the females) was more pronounced after treatment with the chemical mutagen than in the untreated group. Increases in the frequency of abortions and in premature sterility resulted from Endoxan treatment. During the entire observation period, no effects from the intake of radiation-sterilized food were detected. (auth)

**12405** X-RADIATION EFFECTS ON MUSCLE CELL MEMBRANE ELECTRICAL PARAMETERS. Portela, A.; Vaccari, J. G.; Llobera, O.; Campi, M.; Delbue, M. A.; Perez, J. C.; Stewart, P. A.; Gosztonyi, A. E. (Consejo Nacional de Investigaciones Cientificas y Tecnicas, Buenos Aires). Stud. Biophys.; 51: No. 2, 127-144(15 Sep 1975).

Early effects of 100 Kilorads of x rays on muscle cell membrane properties have been measured in sartorius muscles from the South American frog Leptodactylus ocellatus. Threshold strength for rectangular current pulses increased 10% after irradiation, and action potential propagation velocity decreased 10%. Passive membrane parameters were calculated from potential responses to sub-threshold current pulses, assuming conventional cable theory. Specific membrane conductance increased 18% after radiation, membrane capacitance increased 14%, and length constant decreased 10% but membrane time constant was unchanged. Cell diameter decreased 5%, and resting membrane potential decreased 8%, in agreement with results from earlier work. Membrane parameters during an action potential were also evaluated by the phase-plane and current-voltage plot techniques. Irradiation significantly decreased the action potential amplitude, the excitation potential, and the maximum rates of rise and fall of membrane potential. Increases were observed in dynamic sodium and potassium conductances, peak sodium current, and net charge accumulation per action potential. This x-ray dose also produces significant changes in the timing of peak events during the action potential; in general the whole action potential process is slower after irradiation. In conjunction with previously published studies of water permeability and distribution, ion fluxes, and ultrastructure after x irradiation, these results indicate that x rays rapidly produce significant deterioration of excitation processes and electrochemical function, at the plasma membrane as well as within the cell. (auth)

**12406** EFFECT OF IRRADIATION ON IMMUNE RESPONSES. Stewart, C. C.; Perez, C. A. (Washington Univ., St. Louis). Radiology; 118: No. 1, 201-210(Jan 1976).

The radioresistance of antibody-mediated immune response is lowest when radiation is given before antigen, and rises steadily with time after antigen stimulation to reach a maximum when serum antibody is at a maximum, suggesting that antibody-producing cells are highly resistant. Irradiation affects the antibody-mediated response by (1) lengthening the period between stimulation and production of detectable levels of serum antibody, (2) decreasing the rate of increase in serum antibody levels, and (3) decreasing the maximum concentration of serum antibody. Irradiation affects the cell-mediated response by inhibiting immunization and delayed hypersensitivity reactions when administered before antigen. Because the cell-mediated response involves nonlymphoid cells whose precursors are also radiosensitive, irradiation following stimulation may also produce temporary suppression. (auth)

**12407** EARLY IRRADIATION SYNDROME. A Study of the Functional Changes in the Rabbit Following Whole-Body γ Exposure at Sublethal Doses. Dufour, R.; Collignon, Y.; Vincent, F. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection; Ministere des Armees, 75 - Paris (France). Direction Technique des Armements Terrestres); Court, L. (Centre de Recherches du Service de Sante des Armees, 75 - Paris (France)). Bull. Inf. Sci. Tech. (Paris); No. 203, 35-44(May 1975). (In French)

A method of simultaneous observation of several physiological functions was developed in the unanaesthetized rabbit. Arterial blood pressure, local brain circulation, internal body temperature, and arterial blood acido-basic balance were thus followed before, during, and after γ irradiation. There appeared two periods in the development of this early syndrome: they were related to two processes, a central one, mainly of sympathetic origin was hardly sensitive to the dose, the other is dose-dependent. (FR)

**12408** MICROBIOLOGY AND THE EVOLUTION OF THE GASTROINTESTINAL IRRADIATION SYNDROME. Desmettre, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Bull. Inf. Sci. Tech. (Paris); No. 203, 45-49(May 1975). (In French)

Following a review of the literature, the results of investigations on the function of the digestive tract microflora of gnotoxenic rats in the development of the gastrointestinal irradiation syndrome are presented. (FR)

**12409** PROTON-INDUCED CATARACTS. Lemaire, G.; Haye, C.; Grillon, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Bull. Inf. Sci. Tech. (Paris); No. 203, 51-56(May 1975). (In French)

Proton irradiation of the rabbit's eye resulted in injuries of the same nature as those from other ionizing radiations, yet the evolution of the pathological processes thus induced were different since the injuries became stabilized at a precise stage of cataractogenesis. The localization of the radiosensitive sites was verified and a lack of LET effect was noticed. Since mammalian lens are not very different from one another, the results can be extrapolated to man. The hazards to man arising from accidental exposures exist but they are very low. (FR)

**12410** ROLE OF B AND T LYMPHOCYTES IN FORMING CELL CLONES PRODUCING ANTIBODIES. Sterzl, J. (Ceskoslovenska Akademie Ved, Prague. Mikrobiologicky Ustav). Folia Microbiol. (Prague); 19: No. 5, 349-357(1974).

Experiments with the cloning of immunocompetent cells indicate a shift from IgM to IgG during the multiplication of immunologically activated cells derived by proliferation from one precursor. An alternative explanation, i.e., the cooperation of one T cell with two different B cells (IgM and IgG precursors) was experimentally studied. Control experiments indicated that all detected foci were dependent on the production of antibodies and the action of the complement. The number of foci was found to be linearly dependent on the amount of cells transferred to isologous lethally irradiated mice. A time gap existed between the first detection of antibodies by the focus technique (on the 4th day after the transfer) and by the plaque technique with isolated cells (detectable only as of the 6th day after the transfer); early foci contained antibodies but did not produce (secrete) them in a sufficient amount. The transfer of lymphocytes isolated from the spleen, the bone marrow and the thymus showed that the primary response foci were only formed by the B lymphocytes. The transfer of a constant number of the B lymphocytes with an increased number of the T lymphocytes did not change the number of Ab-forming foci; there was an increase, however, in the number of individual cells producing antibodies detected by the plaque technique, i.e., the number Ab-forming cells per individual clone (focus). The shift from IgM to IgG was made possible through the action of the T lymphocytes. The auxiliary role of the T lymphocytes in the primary response is discussed. (auth)

**12411** ROLE OF ADRENAL CORTEX IN EXPERIMENTAL ACUTE RADIATION DISEASE. Pospisil, M. (Ceskoslovenska Akademie Ved, Brno. Biofysikalni Ustav). Cesk. Fysiol.; 23: No. 5, 409-422(Sep 1974). (In Czech).

The multi-stage course of the increase in the adrenal cortex activity typical of the radiation syndrome is described. Changes in the adrenal cortex function during the radiation syndrome and the mechanism of their origin are discussed. Also dealt with is the contribution of the adrenal hormones to metabolic and haematopoietic function changes in the irradiated organism. The effect of the hormones on mortality of the irradiated animals is reported as well as the effect on radiosensitivity of an increased resistance of the organism to radiation burden following the action of the same or of a different stressor. It is assumed that many of the manifestations of this so-called non-specific resistance are conditional on the adrenal axis activation. (INIS)

**12412** EFFECT OF CONTINUOUS GAMMA IRRADIATION ON RAT SERUM MALATE AND LACTATE DEHYDROGENASE ACTIVITY. Paulikova, E.; Ahlersova, E.; Ahlers, I.; Praslicka, M. (Univerzita P. J. Safarika, Kosice (Czechoslovakia). Prirodovedecka Fakulta). Biologia (Bratislava); 29: No. 9, 701-704(1974).

The effect was studied of continuous whole-body gamma irradiation on the activity of the malate and lactate dehydrogenases of the blood serum in rats. The question is also discussed of the environment sometimes inducing changes similar to those resulting from continuous irradiation. (INIS)

**12413** SECONDARY DECREASE IN CELL POPULATION AND THE SECOND WAVE OF PREMATURE DIFFERENTIATION OF CRYPT CELLS IN THE INTESTINAL EPITHELIUM OF IRRADIATED MICE. Kononenko, A. M.; Monastyrskaya, B. I.; Fol'ke, Yu. (Inst. of Nuclear Physics, Leningrad). Tsitologiya; 16: No. 6, 757-764(Jun 1974). (In Russian).

After a whole-body, x ray irradiation of mice at a dose of 400 rads the overcompensation of mitoses and the number of cells in the recuperating, intestinal epithelium is replaced by a secondary decrease in these indices. By a modeling analysis it was shown that on the fifth day after irradiation the number of cells is less than the number corresponding to the observed mitotic activity. In this period it was found that there is an accelerated differentiation of most of the crypt cells, which undergo premature maturation. The data indicate that during repair of the irradiated, intestinal epithelium the periods where reproduction predominates over differentiation are replaced by periods where differentiation of the crypt cells dominates. In the first hours after irradiation (during the radiation block of mitoses), observations were made of the death of granulocytes and lymphocytes penetrating into the crypts, but necrosis of the epithelial cell was not seen. It is possible that the contradiction in the literature data on the dose dependence of the premitotic death of cells in the crypts is to some degree associated with interference of necrosis of the epithelial cells and of the granulocytes and lymphocytes penetrating into the crypts. (tr-auth)

12414 CHANGES IN SUBCOMMISSURAL ORGAN IN IRRADIATION SYNDROME. Miline, R.; Devecerski, V.; Dedic, M.; Miline, J. (Institute of Histology and Embryology, Faculty of Medicine and Institute of Radiology, Clinical Hospital, Novi Sad (Yugoslavia)). Endocrinol. Exp.; 8: No. 4, 299-309(Dec 1974).

In mature rats individually irradiated by a lethal dose of 800 R and sacrificed 72 hr after irradiation, the following changes were found in the structure of the subcommissural organ (SCO): hypertrophy of nuclei in ependymocytes and hypendymocytes; an increased activity of alkaline and acid phosphatase, DPNH-diaphorase, nonspecific esterase and succinodehydrogenase; polymorphism of ependymocytes nuclei, the enlargement of perinuclear space and the occurrence of cisternae of endoplasmic reticulum, numerous secretory granules in both poles of ependymocytes, hypertrophy of the Golgi zone, hypertrophy of mitochondria in hypendymocytes, an increased number of secretory granules and of primary and secondary lysosomes, the occurrence of intracytoplasmic cavities discharging their content into intercellular spaces and a confrontation with periodic structural bodies, and the presence of numerous vesicles within the endings of amyelinic fibres. These changes presumably show the progressive reaction and the active role of SCO in maintaining the disturbed hydromineral balance in radiation syndrome. (auth)

12415 IMPORTANCE OF TISSUE HYPOXIA FOR AN INCREASED RADIORESISTANCE OF MAMMALIAN ORGANISM. Kuna, P. (Vojensky Lekarsky Vyzkumny a Doskolovaci Ustav J. E. Purkyne, Hradec Kralove (Czechoslovakia)). Vojen. Zdrav. Listy; 42: No. 3, 128-132(May 1973). (In Czech).

The effect of tissue hypoxia alone and in combination with radioprotective substances on an increased resistance of the mammalian organism is briefly reviewed. An extensive list of references is added. (INIS)

12416 $G_2$ ARREST OF EHRLICH ASCITES TUMOR CELLS DURING THE TUMOR REGRESSION IN RATS. Janik, P. (Instytut Onkologii, Warsaw (Poland)). Neoplasma; 21: No. 4, 415-419(1974).

Ehrlich tumor cells were transplanted into normal and irradiated rats. On the 6th day after transplantation, when the rejection of tumor cells in control animals is known to begin the rats received an injection of $^3$H-TdR so that the duration of the $G_2$ period could be determined. This was found to be longer for the tumor growing in normal rats, as shown by the respective waves of labelled mitoses. Another group of rats with 6-day old tumor were injected with $^3$H-TdR five times at 3 hr intervals. Labelled mitoses of tumor growing in the rats that received $^3$H-TdR only, the rats with partly removed tumor and the rats with the tumor transplanted from the latter animals at the start of the 8-hour harvesting period, were scored. The retransplanted tumor as compared with both controls showed a decreased proportion of labelled mitoses and an increase in the mitotic indices. The results indicate that an immune reaction directed against Ehrlich cells leads to the extension of the $G_2$ period, as well as to the $G_2$ block, which may be reversed easily upon removing the causative factor(s). (auth)

12417 EFFECT OF ULTRASOUND ON THE FORMATION OF HAEMOPOIETIC TISSUE COLONIES IN SPLEEN. Hrazdira, I.; Horky, D. (Universita J. E. Purkyne, Brno (Czechoslovakia). Lekarska Fakulta); Rakova, A.; Vacek, A. (Ceskoslovenska Akademie Ved, Brno. Biofysikalni Ustav). Folia Biol. (Prague); 20: No. 6, 430-432(Dec 1974).

The effect of ultrasound on the functional properties of bone marrow cells was studied by the method of formation of exogenous colonies in the spleen of mice, strain C57BL, whole-body irradiated by 600 R. The haemopoietic cells, which survived the ultrasound treatment without any morphological changes, produced a greater number of colonies in the recipient spleen than unsonicated control cells. The stimulatory effect of low-intensity ultrasound was thus unambiguously proved. (auth)

12418 STUDY OF THE VITAMIN A CONTENT AND ACTIVITY OF RETINYL-PALMITATE HYDROLASE IN THE SMALL INTESTINE AND ITS CELLULAR MEMBRANES IN THE PRESENCE OF INSUFFICIENT VITAMIN A AND IRRADIATION. Leutskii, K. M.; Lyubovich, E. N.; Sovtysik, D. D. (Chernovtsy State Univ., USSR). Dokl. Akad. Nauk SSSR; 220: No. 4, 972-974(1 Feb 1975). (In Russian).

Female rats were given an x-ray dose of 600 R and killed three hours after the irradiation. The vitamin A content, and amounts of retinyl ether and retinol were determined in the mucous membrane of the small intestine, and its cellular membranes. The total content of the ether and alcohol forms of retinol fell from 23 to 15.8 micrograms/g in the presence of insufficient vitamin A and irradiation at a dose of 600 R. The activity of the retinyl-palmitate hydrolase in the presence of insufficient vitamin A falls sharply in the mucous membrane of the small intestine. An even sharper fall in enzyme activity is observed with the simultaneous effect of insufficient vitamin A and irradiation. The main reason for these changes is apparently a disturbance in protein synthesis. (SJR)

12419 PREVENTION OF RADIATION DAMAGE BY THE IMMEDIATE BEE-STING METHOD. Akopyan, S. A.; Akopyan, M. A. (Erevan State Univ.). Zh. Eksp. Klin. Med.; 14: No. 3, 29-33(1974). (In Russian).

The direct effect of bee stings on mice and rats was studied experimentally in order to determine the animals' radiation sensitivity and survival. Multiple bee stings (10) before irradiation in some way increased the radiation resistance of the animals studied. Probably, the bee poison injected with the sting has a radiation prophylactic value. The number of stings needed, the time factor, and the therapeutic property of the stings were determined. (tr-auth)

12420 IMPAIRED RADIOPROTECTIVE CAPACITY AND REDUCED PROLIFERATIVE RATE OF BONE MARROW FROM NEONATALLY THYMECTOMIZED MICE. Zipori, D.; Trainin, N. (Weizmann Inst. of Science, Rehovoth, Israel). Exp. Hematol.; 3: 1-11(1975).

The colony forming capacity of bone marrow from neonatally thymectomized mice is reduced in comparison with that of normal animals. In addition to this quantitative change, we observed that the bone marrow of thymectomized animals has a reduced radioprotective effect upon inoculation into lethally irradiated recipient mice. It was also found that the cellularity of spleen colonies derived from bone marrow of thymectomized animals is lower than that of intact controls. In vivo uptake of $^3$H-thymidine into cells of spleen colonies and rate of DNA synthesis measured in vitro were found to be reduced in cells derived from bone marrow of thymectomized donors. The initially observed reduction in colony forming capacity of bone marrow from neonatally thymectomized mice could be reversed by thymus reimplantation. (DA)

12421 ALLOGENEIC UNRESPONSIVENESS TO ORTHOTOPIC CARDIAC TRANSPLANTS IN DL-A-IDENTICAL RADIATION CHIMERAS. Boyd, A. D.; Spencer, F. C.; Hirose, H.; Engelman, R. M.; Cannon, F. D.; Ferrebee, J. W.; Rapaport, F. T. (New York Univ., NY). Transplant. Proc.; 7: No. 4, 475-477(Dec 1975).

Nine Cooperstown beagles of known DL-A genotypes were exposed to supralethal total-body irradiation and received bone-marrow allografts from DL-A-identical donors. Four to 5 months later, the resulting chimeras received orthotopic cardiac allografts from their corresponding donors of marrow. Six chimeras died of operative complications in the immediate postoperative period. The other 3 chimeras survived from 173 to 547 days; 1 dog died at 173 days as a result of right-sided heart failure, secondary to stenosis at the site of the pulmonary artery anastomosis. The other two recipients continue to be active and healthy at 545 and 547 days. The results indicate that dogs can be rendered specifically tolerant to orthotopic cardiac allografts by supralethal total-body irradiation and the transplantation of marrow obtained from the prospective allograft donor. (auth)

12422 INDUCTION OF TOLERANCE TO THIRD-PARTY DONOR ORGANS IN CANINE RADIATION CHIMERAS. Rapaport, F. T.; Bachvaroff, R. J.; Watanabe, K.; Cannon, F. D.; Ayvazian, J. H.; Blumenstock, D.; Ferrebee, J. W. (New York Univ., NY). Transplant. Proc.; 7: No. 4, 471-474(Dec 1975).

Gamma-irradiated dogs reconstituted with bone marrow obtained from a first DL-A species and a histocompatibility pedigree (HP) identical donor were challenged within 12 hr after marrow transplantation with a renal allograft obtained from a second DL-A and HP-identical donor. Fourteen of 17 renal transplants performed under such conditions currently survive with normal function for 94 to 500 days. This observation may be of relevance to further studies of the immunogenetics of histocompatibility in the canine species. (HLW)

12423 ENGRAFTMENT OF ALLOGENEIC DOG BONE MARROW. Vriesendorp, H. M.; Zurcher, C.; van Bekkum, D. W. (Radiobiological Inst. and Inst. for Experimental Gerontology, Rijswijk, Netherlands). Transplant. Proc.; 7: No. 4, 465-468 (Dec 1975).

Resistance to allogeneic bone-marrow grafts (AR) was found to occur in many species, including the dog. The i.v. administration of silica particles suppressed Ar in vivo in this species. Genetic studies provide suggestive evidence for the existence of a previously unrecognized system or systems in the canine major histocompatibility complex controlling AR. (auth)

12424 MARROW GRAFTS BETWEEN CANNINE LITTERMATES SHOWING ONE-WAY NONSTIMULATION IN MIXED LEUKOCYTE CULTURE. Storb, R.; Weiden, P. L.; Schroeder, M. L.; Graham, T. C. (Univ. of Washington, Seattle). Transplant. Proc.; 7: No. 4, 459-460(Dec 1975).

Bone marrow grafts were carried out using two groups of donor-recipient pairs. In group 1 the mixed leucocyte culture (MLC)-nonreactive littermate served as the donor for the MLC-reactive littermate; in group 2 the MLC-reactive littermate served as the donor for the MLC-nonreactive littermate. Recipients were given 1200 R total-body radiation from $^{60}$Co sources. Preliminary results of these transplants are described and compared with previous data obtained in littermates matched or mismatched at the canine histocompatibility complex. (HLW)

**12425** PROTECTION OF LETHALLY IRRADIATED MICE WITH ALLOGENEIC FETAL LIVER CELLS: INFLUENCE OF IRRADIATION DOSE ON IMMUNOLOGIC RECONSTITUTION. Tulunay, O. (Univ. of Minnesota, Minneapolis); Good, R. A.; Yunis, E. J. Proc. Natl. Acad. Sci. U.S.A.; 72: No. 10, 4100-4104(Oct 1975).

After lethal irradiation long-lived, immunologically vigorous C3Hf mice were produced by treatment with syngeneic fetal liver cells or syngeneic newborn or adult spleen cells. Treatment of lethally irradiated mice with syngeneic or allogeneic newborn thymus cells or allogeneic newborn or adult spleen cells regularly led to fatal secondary disease or graft-versus-host reactions. Treatment of the lethally irradiated mice with fetal liver cells regularly yielded long-lived, immunologically vigorous chimeras. The introduction of the fetal liver cells into the irradiated mice appeared to be followed by development of immunological tolerance of the donor cells. The findings suggest that T-cells at an early stage of differentiation are more susceptible to tolerance induction than are T-lymphocytes at later stages of differentiation. These investigations turned up a perplexing paradox which suggests that high doses of irradiation may injure the thymic stroma, rendering it less capable of supporting certain T-cell populations in the peripheral lymphoid tissue. Alternatively, the higher and not the lower dose of irradiation may have eliminated a host cell not readily derived from fetal liver precursors which represents an important helper cell in certain cell-mediated immune functions, e.g., graft-versus-host reactions, but which is not important in others, e.g., allograft rejections. The higher dose of lethal irradiation did not permit development or maintenance of a population of spleen cells that could initiate graft-versus-host reactions but did permit the development of a population of donor cells capable of achieving vigorous allograft rejection. (auth)

**12426** IN VITRO CORRELATES OF THE IN VIVO COURSE OF THE CANINE TRANSMISSIBLE VENEREAL TUMOR STUDIED BY MIXED LYMPHOCYTE–TUMOR CULTURES. Hess, A.; Cunningham, B.; Bennett, B. T.; Epstein, R. (Univ. of Chicago). Transplant. Proc.; 7: No. 4, 507-511(Dec 1975).

Studies were conducted to measure the cell-mediated immune response to transmissible venereal tumor (TVT) cells by the mixed lymphocyte-tumor-cell culture (MLTC), to measure the effect of autologous progressor sera on tumor-cell-induced blastogenesis, and to correlate MLTC reactivity with the clinical course of the tumor. Tumor cells were irradiated with 2100 rads from a single $^{60}$Co source. The response during the progressive phase of tumor growth correlated with the clinical outcome of the tumor. Animals that were significantly stimulated by TVT cells in MLTC had eventual tumor regression. Metastatic dissemination of tumor occurred in animals that were nonreactive to TVT cells in the progressive phase of tumor growth. (HLW)

**12427** INAPPLICABILITY OF CEA-7 AS A CANINE BONE MARROW TRANSPLANTATION MARKER. Bull, R. W.; Vriesendorp, H. M.; Zweibaum, A.; Swisher, S. N. (Michigan State Univ., East Lansing). Transplant. Proc.; 7: No. 4, 575-577(Dec 1975).

Procedures are described for histocompatibility matching,, erythrocyte typing, and CEA-7 serum substance assay. Results of CEA-7 serum substance assays in CEA-7 positive recipients are shown by means of a graph. After lethal total body irradiation, the CEA-7 substance was demonstrable in the recipients' serum for only 7 to 10 days, with disappearance of the substance from the serum for an equivalent period of time and its reappearance thereafter. (HLW)

## Invertebrates

*Refer also to abstract 12256.*

**12428** (CENA-BC-019) INFLUENCE OF HUMIDITY, TEMPERATURE, AND GAMMA RADIATION ON THE BIOLOGY OF ZABROTES SUBFASCIATUS (BOHEMANN) (COLEOPTERA, BRUCHIDAE) ON BEANS. Wiendl, F. M.; Link, D. (Centro de Energia Nuclear na Agricultura, Piracicaba (Brazil)). Jun 1974. 23p. (In Portuguese) INIS.

The determination of the influence of the environment and the effect of gamma radiation on the development of a population of Zabrotes subfasciatus (Boh.) in stored beans is described. The increase in the doses of the gamma radiation (0; 1.15; 2.25 and 4.5 krad) maintained within the substerilization rates, had a negative influence on reproduction. The larger dose (4.5 krad), however, was not yet sufficient to cause complete sterilization. It was also noted that when the insects were placed under a constant temperature of 30°C and at 80% humidity, they reproduced more quickly than when under varying conditions, e.g., between 8 and 36°C and humidity between 40% and 95%. Besides this variation in temperature and humidity and the increase in the doses, there was also an increase in the time of developing cycle of the insects. (INIS)

**12429** (CONF-7404111-, pp 861-885) STERILITY APPROACH FOR INSECT PEST CONTROL. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

The following studies were conducted: feasibility of using sterile females along with sterile males in the control of the red palm weevil, Rhynchophorus ferrugineus; sterilization of the red palm weevil by metepa and hempa; and loss caused by sterile adults of stored grain pests in wheat. (HLW)

**12430** (INIS-mf-1820) GENETIC RADIATION DAMAGE AND FOOD IN DROSOPHILA MELANOGASTER (MEIGEN). The Influence on the Live Yeast in the Food Upon the Frequency of Sex-Linked Lethals Induced by X-rays During Spermatogenesis. Schouten, S. C. M. (Rijksuniversiteit Utrecht (Netherlands)). 27 Jun 1973. 82p. (In Dutch). INIS.

Thesis.

The influence of the presence of live yeast in the food of the adult wild type Drosophila males upon the frequency of X-ray induced dominant and sex-linked recessive lethal mutations was studied. Sensitivity to X-rays is highest in early spermatids and spermatocytes. These stages responded with a decrease in induced sex-linked recessive lethal mutations to a deficiency of live yeast in the food. Also RNA synthesis in the testes of males fed with live yeast-deficient food was reduced. Arguments are presented that the yeast effect is due to impaired efficiency of a repair process of chromosomal breaks in yeast-deficient animals. (auth)

**12431** EFFECTS OF THE IRRADIATIONS X ON THE REPRODUCTIVE POWER OF ACANTHOSCELIDES OBTECTUS SAY (COLEOPTERA: BRUCHIDAE). Biemont, J. C. (Tours Univ., 37 (France)). Ann. Zool. Ecol. Anim.; 5: No. 4, 581-591 (1973). (In French).

Effects of ionizing radiations were studied in Acanthoscelides obtectus. Chorion covered ovocytes stored in lateral oviducts were more sensitive than young growing oocyte. On the other hand, studies of fine structure on ovarioles of treated females show that damage to oocyte membrane can explain vitellogenesis perturbations. (FR)

**12432** PHYSICAL AND CHEMICAL MUTAGENESIS ON A MYCOPHAGOUS NEMATODE APHELENCHOIDES COMPOSTICOLA (M. T. FRANKLIN, 1957). Person, F.; Brun, J. (Lyon-1 Univ., 69- Villeurbanne (France)). Ann. Zool. Ecol. Anim.; 6: No. 1, 111-130(1974). (In French)

Chemical mutagens as EMS, acriflavine, acridine, colchicine, nitrous acid and physical mutagens, such as X rays, have been used on the gonochoric mycophagous nematode Aphelenchoides composticola. They show a nematicide activity due to their toxicity on treated nematodes and to the induction of lethal mutations affecting particularly early stages of gametogenesis. They produce abnormal strain dwarfs or giants (up to 25% of the population). Concentrations of chemical mutagens varying from 0.2 to 0.5% correspond to the optimal production of abnormalities. Similar results were obtained by irradiation to 2000 R. The action of the mutagens shows some differences: EMS and X rays generally produce dwarfs, whereas acriflavine, acridine, colchicine, or nitrous acid induced only giants. Abnormal strains appear: in the $F_1$ generation by X rays or acridine treatments; in the $F_2$ or $F_3$ generation by acriflavine, colchicine, nitrous acid, or EMS action. The abnormal strains could be either variants or mutants and from these we select: four dwarfs B, C, D, E, induced by EMS 0.5% for 24 hours appearing in the $F_3$ generation; or dwarf F induced by irradiation of 1500 R appearing in the $F_1$ generation. All these selected mutants are autosomal recessive single factors D and C controlled by two alleles of the same locus. (FR)

**12433** COMPARATIVE RADIOSENSITIVITY IN THE CLASS INSECTA. Willard, W. K.; Cherry, D. S. (Clemson Univ., SC). J. Theor. Biol.; 52: No. 1, 149-158(Jul 1975).

A radiosensitivity index ($LT_{50}$/mean longevity) was correlated with the mean longevity and dry weight of 37 insect species (both sexes of 12 species) representing eight orders. Curvilinear

regression analysis relating radiosensitivity to mean longevity and mean dry weight indicated that 46.3% of the observed variation could be attributed to longevity and 32.6% to the dry weight of the species. In general, large long-lived adults were more radiosensitive than small short-lived adults. Correlation of the phylogeny of insect orders and order groupings with the radiosensitivity index was found to be poor. However, when the index was related to longevity, there was a tendency for species comprising the major orders investigated to occur in groups along the predicted curve. (auth)

**12434** TENTATIVE IMMUNIZATION OF RATS USING IRRADIATED LARVAE OF STRONGYLOIDES RATTI. Rego, A. A. (Instituto Oswaldo Cruz, Rio de Janeiro); Kahtalian, A. Rev. Bras. Biol.; 32: No. 1, 97-99(Jun 1972). (In Spanish).

The authors used γ radiation from cobalt-60 therapeutic equipment to irradiate larvae of Strongyloides ratti, in order to obtain an immunitary response in albino rats (Rattus norvegicus var. albinus). Doses up to 54.000 R failed to immobilize the larvae. Doses of 50.000 to 54.000 R prevented the sexual maturation and installation of worms in the digestive tract of rodents, but a posterior inoculation with normal larvae (8, 10, and 15 days after) produced normal infection, but fewer parasites. The authors suppose that a immunitary reaction was not created to protect the rats from further infections. Doses of 10.000 and 20.000 R changed the life cycle. The sexual maturation was complete within 6 days instead of normal 4 days. (auth)

# Radionuclide Effects (Internal Source)

**12435** (LA-UR-75-2272) OCCUPATIONAL EXPOSURE ESTIMATES FOR PLUTONIUM FUEL CONVERSION AND FABRICATION OPERATIONS. Mulkin, R.; Mayfield, D. L.; Graf, J. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-Eng-36. 7p. (CONF-760202-22). Dep. NTIS $3.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Estimates were made for occupational exposure associated with operation of two commercial scale production plant models, one a plutonium conversion plant and the other a mixed oxide fuel fabrication plant. The estimates were made by visualizing production and support operations through the viewpoint of a production manager responsible for scheduling and determining manpower requirements. Model plants were described in terms of design basis radiation zones and contamination zones. Control levels for airborne activity appropriate for plutonium operations were used to develop airborne concentrations. Airborne concentrations and dose rates were folded with occupational residence times in each type of zone to generate occupational dose figures. The integrated dose for each occupational group was summed to generate a number for the plant population. Results were 300 man rem per year external exposure for the conversion plant, and 350 man rem per year external exposure for the fabrication plant. Average annual internal dose was greatest for the lung and was found to be 0.16 and 0.19 rem per man (lung dose) at the respective plants. (auth)

## Man

*Refer also to abstracts 11525, 12002, 12029, and 12342.*

**12436** (DHEW/FDA-76-8022) USE OF IODINE-125 FOR INTERSTITIAL IMPLANTS. Hilaris, B. S.; Holt, G. J.; St. Germain, J. (Memorial Hospital, New York (USA)). Nov 1975. 41p. Bureau of Radiological Health, Rockville, MD.

The use of iodine-125 seeds for the implant irradiation of malignant tumors was investigated in terms of efficacy and radiological safety. Studies over a 3-year period at the Memorial Hospital for Cancer and Allied Diseases in New York were supported by the Bureau of Radiological Health. The final report indicates that iodine-125 is a satisfactory substitute for the high energy gamma emitters used in interstitial irradiation. Tumor doses of 16,000 rads were tolerated without undesirable early side effects. Methods for routine calibration of seeds and determination of dose distribution within patients were developed. A theoretical value for the absorbed dose constant of iodine-125 was computed. Personnel monitoring of hospital staff and survey of patients with sources in situ showed a marked reduction in exposure from these sources. Disadvantages were noted in the difficulty of locating lost sources and need to shield patients after discharge. (auth)

**12437** (LA-RU-75-2253) OPERATIONAL HEALTH PHYSICS AT THE LOS ALAMOS MESON PHYSICS PROTON ACCELERATOR. Engelke, M. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-Eng-36. 8p. (CONF-760202-23). Dep. NTIS $3.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

The operational health physics practices and procedures at the Clinton P. Anderson Los Alamos Meson Physics Facility (LAMPF), a medium energy, high intensity proton accelerator are reviewed. The operational philosophy used for the control of personnel exposures and radioactive materials is discussed. A particular operation involving the removal of a radioactive beam stop reading in excess of 1000 R/h is described. (auth)

**12438** CHROMOSOMAL DAMAGE AFTER INTRA-ARTICULAR INJECTION OF DIFFERENT COLLOIDS OF $^{90}Y$. Gumpel, J. M.; Stevenson, A. C. (Northwick Park Hospital and Clinical Research Centre, Harrow, Eng.). Rheumatol. Rehabil.; 14: No. 1, 7-12 (Feb 1975).

Chromosomal damage to circulating lymphocytes occurs following injection of intra-articular radioisotopes. Differences in the degree of chromosomal damage have been shown with various colloidal forms of yttrium-90, and the severity of these changes has been shown to correlate with the degree of leakage of radioisotope to the draining lymph node rather than with whole-body irradiation. The long-term significance of these changes is not yet known, but it is clearly prudent to use the colloidal form least associated with chromosomal damage. (auth)

**12439** BIOLOGICAL EFFECTS FROM RADIOACTIVE FALLOUT. Casarett, A. P.; Thompson, J. C. Jr. Prog. Biometeorol., Div. A; 1: No. 1A, 356-364(1974).

The following factors determining the hazard from fallout nuclides are discussed: amount produced; radioactive half-life; transfer to man; and metabolism in the body. It is pointed out that the radioisotopes most likely to represent significant hazards are $^{131}I$, $^{90}Sr$, $^{89}Sr$, $^{137}Cs$, and $^{14}C$. Radiation exposures to human populations from these radioisotopes are discussed and tables are presented to show average exposures and dose commitments to gonads, bone, and bone marrow. Other topics discussed are biological effects from fallout, tumor production, and genetic effects. (HLW)

**12440** OBSERVATIONS ON TRANSITION OF POLYCYTHAEMIA VERA INTO ACUTE OR CHRONIC GRANULOCYTIC LEUKAEMIA DURING TREATMENT WITH RADIOACTIVE PHOSPHORUS $^{32}P$. Krasnik, W. (Zespolu Wojewodzkich Przychodni Specjalistycznych, Posnan, Poland). Pol. Tyg. Lek.; 30: No. 6, 233-236(10 Feb 1975). (In Polish).

In a group of 172 cases of polycythaemia vera treated with radioactive phosphorus $^{32}P$ acute granulocytic leukaemia developed in 3 cases and chronic granulocytic leukaemia in 6 cases. Development of acute granulocytic leukaemia during treatment with radioactive phosphorus for polycythaemia vera may be considered with a result of leukaemia-inducing action of ionizing radiation. Transition of polycythaemia vera into chronic granulocytic leukaemia seems to be a nautral outcome of this complex myeloproliferative syndrome in patients with survival prolonged by treatment with $^{32}P$. (auth)

**12441** RESULTS OF THE TREATMENT OF TOXIC THYROID ADENOMAS BY $^{131}I$. Vallee, G.; Doumith, R. (Hopital Necker-Enfants-Malades, Paris). Ann. Endocrinol. (Paris); 35: 45-47 (1974). (In French).

Two hundred and four observations of thyroid adenomas treated by $^{131}I$ had been studied by distinguishing one group of patients having received doses superior to 15,000 rads and a second group composed of patients having received doses inferior to 10,000 rads. In the first group, the results are identical to those obtained by other authors. In the second group the differences observed by rapport to the first group are a longer clinical recovery time and a smaller proportion of nodules which became cold after treatment. In our opinion, $^{131}I$ as a treatment for toxic adenomas must be used more frequently. The dose used must be calculated in taking into consideration the intensity of the clinical signs of thyrotoxicosis. (auth)

## Animals

**12442** ALPHA-EMITTING PARTICLES IN LUNGS. Bair, W. J.; Kellerer, A.; Stannard, J. N.; Thompson, R. C. Washington, DC; National Council on Radiation Protection and Measurements (1975). 33p. (NCRP-46).

The potential for release of particles of plutonium and transplutonium alpha-emitting elements from nuclear power generating facilities poses urgent questions concerning spatial distribution of dose and the resultant biological effects. These questions are of special importance in the setting of standards for radiation exposure. The substantial body of experimental animal data available at the present time indicates that particulate Pu in the lung is no greater hazard than the same amount of Pu more

uniformly distributed throughout the lung. This is consistent with the theoretical analysis of the microscopic distribution of energy absorption in the two cases. It is therefore concluded that the current NCRP practice of averaging over the lung the absorbed dose from particulate alpha-emitting radionuclides is a defensible procedure when employed in conjunction with appropriate dose limits. A more precise consideration of the spatial distribution of absorbed dose cannot be utilized to advantage in the derivation of permissible exposure limits without a better understanding of the mechanisms involved in the translation of dose to effect. (auth)

**12443** CANINE OSTEOSARCOMA KARYOTYPES FROM AN ORIGINAL TUMOR, ITS METASTASIS, AND TUMOR CELLS IN TISSUE CULTURE. Taylor, N.; Shifrine, M.; Wolf, H. G.; Trommershausen-Smith, A. (Univ. of California, Davis). Transplant. Proc.; 7: No. 4, 485-493 (Dec 1975).

Radiation-induced osteosarcoma, its metastasis, and cells grown in tissue culture were karyotyped. Both hypodiploid and hyperdiploid stem lines were observed. The hypodiploid line contained 45-55 chromosomes with 10 to 15 abnormal metacentric and submetacentric chromosomes and one subtelocentric marker. The hyperdiploid line contained 90 to 105 chromosomes with 20 to 30 abnormal metacentric and submetacentric chromosomes with two subtelocentric markers. Karyotypic analysis can be used to monitor osteosarcomas maintained in tissue culture. (auth)

# Nuclide Kinetics and Toxicology

## Man

*Refer also to abstracts 11479 and 12022.*

**12444** (AECL-5244) COMPARTMENT MODELS OF RADIOIODINE IN MAN. Johnson, J. R. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Oct 1975. 30p. Dep. NTIS (US Sales Only) $5.00.

The differential equations governing the flow of iodine through a three-compartment model of iodine metabolism in man have been solved and the solutions compared to those obtained from two-compartment models. The boundary conditions used were those appropriate for a single acute exposure to radioiodine. The urinary excretion equation derived from the solutions to the three-compartment model exhibits a minimum at four days after the exposure time. This minimum can be used to calculate a maximum value for thyroid burden using a single urinary excretion rate measurement, and in conjunction with this value, an optimum urinary sampling frequency for the different radioiodines can be calculated. (auth)

**12445** (CEA-R-4708) STRONTIUM-90 LEVELS IN HUMAN BONES COLLECTED IN 1974. Jeanmaire, L.; Patti, F.; Gros, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service de Recherches Toxicologiques et Ecologiques). Nov 1975. 12p. (In French). Dep. NTIS (US Sales Only) $4.50.

Strontium-90 levels as well as some values for stable strontium in human bones collected in the Paris area during 1974 are presented. There is a general trend towards a decrease of radioactive contamination as compared with last year. (auth)

**12446** (CONF-751126-3) GROSS DISTRIBUTION OF $^{241}$Am IN A MAN SEVEN YEARS AFTER INHALATION. Toohey, R. E.; Essling, M. A. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 13p. Dep. NTIS $4.50.

From IAEA international symposium on biological effects of low level radiation pertinent to protection of man and his environment; Chicago, Illinois, USA (3 Nov 1975).

The gross distribution of $^{241}$Am remaining in a man seven years after exposure to airborne Am particles was determined by several techniques. Measurements were made of the radiation with NaI(Tl) crystals, one above and one below the supine subject at seven equally spaced points along the long axis. The patterns obtained indicated skeletal deposition in addition to material in the thorax. More detail was obtained from a longitudinal profile scan made at 10 cm intervals with a slit-collimated detector. A general labelling of the skeleton consistent with bone surface deposition was observed, together with a pronounced increased concentration in the thorax. A transverse profile scan was made at the point which had yielded the highest counting rate in the longitudinal scan. Unequivocal evidence for a lung burden was observed in the asymmetry of this scan. The presence of the long-term lung burden was further confirmed by measurements made over the chest with a gas-filled proportional counter. (auth)

**12447** (CONF-751205-5) EXCRETION RATE AND RETENTION OF PLUTONIUM 10,000 DAYS AFTER ACQUISITION. Rundo, J.; Starzyk, P. M.; Sedlet, J.; Larsen, R. P.; Oldham, R. D.; Robinson, J. J. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 12p. (SR-6/23). Dep. NTIS $4.50.

From IAEA international seminar on diagnosis and treatment of incorporated radionuclides; Vienna, Austria (8 Dec 1975).

Three persons who had been injected with known amounts of plutonium in 1945 to 1947, were hospitalized on a metabolic ward in 1973. All excreta were collected for at least eight days and the samples were analyzed for plutonium. For the two subjects who had been injected intravenously with tetravalent $^{239}$Pu as the citrate, the urinary excretion rates were 7.6 and 4.7 pCi/day at approximately $10^4$ days after injection; these rates corresponded to $2.52 \times 10^{-3}$ percent of the injected doses per day respectively. The fecal excretion rates were about 40 percent of the urinary rates. The third subject received an intramuscular injection of hexavalent $^{238}$Pu as the nitrate, in the left leg, which was amputated four days later. Almost 50 percent of the amount injected was found at the injection site and the urinary excretion rate about 9500 days later was 0.06 pCi/day, corresponding to not less than $1.2 \times 10^{-4}$ percent of the initial systemic burden. The excretion rate and retention of $^{239}$Pu up to 10,000 days post-injection were calculated. (CH)

**12448** (N-75-17083) CONTINUED INVESTIGATION OF KINETIC ASPECTS OF BONE MINERAL METABOLISM. Final Report, 1 February 1973-28 February 1974. Palmer, H. E. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 26 Feb 1974. Contract NAS9-13235. 29p. (NASA-CR-141607). NTIS $3.75.

The total body calcium in humans was determined by measuring expired Ar-37 after neutron irradiation. The excretion of Ar-37 from humans was found to be much slower than the excretion from rats and dogs, and to be related to the age of a person. A study of the uniformity of the Ar-37 production throughout the thickness of the body was studied using phantoms. The results indicate that it should be possible to obtain a uniformity within plus or minus 3 percent for the production of Ar-37 per unit of calcium by using a bilateral irradiation. New low background, large volume proportional counters were developed and constructed, for more sensitive measurement of Ar-37 in the expired air from patients. A new irradiation enclosure was developed for measuring total body calcium in rats by the Ar-37 method. With this enclosure the Ar-37 production per gram of calcium is constant with a standard deviation of plus or minus 2.8 percent for any size rat between 100 and 500 grams. The use of Na-22 as measure of bone replacement in the fractured femur of a dog was not successful. (auth)

**12449** FRACTIONAL INTESTINAL ABSORPTION AND RETENTION OF CALCIUM MEASURED BY WHOLE-BODY COUNTING. Application of a Power Function Model. Pors Nielsen, S.; Baerenholdt, O.; Munck, O. (Glostrup Sygehus, Copenhagen). Scand. J. Clin. Lab. Invest.; 35: No. 3, 197-203 (May 1975).

By application of a power function model, fractional intestinal calcium absorption was investigated with a new technique involving whole-body counting after successive oral and intravenous administration of standard doses of $^{47}$Ca. The fractional calcium retention 7 days after the oral load of $^{47}$Ca was also measured. Fractional calcium retention averaged 30.3% in normal subjects and 11.5% in 11 patients with intestinal malabsorption. In the same groups fractional calcium absorption averaged 46.6% and 16.4%, respectively. Fractional calcium retention and intestinal calcium absorption were significantly correlated to body surface area, and there was a well-defined relation between fractional retention and absorption of calcium. These studies demonstrate that measurements of fractional retention and fractional intestinal absorption of calcium can be combined by the use of a whole-body counter, that fractional retention and intestinal absorption are proportional to total body surface area and therefore probably also to the total bone mass, and that fractional retention and absorption are so closely interrelated that fractional absorption can be estimated from fractional retention with reasonable accuracy in normal subjects. (auth)

**12450** INTERNAL EXPOSURE TO RADIONUCLIDES. Composition of First Aid Kits. Ducousso, R.; Pasquier, C. (Centre de Recherches du Service de Sante des Armees, 92- Clamart (France)). Med. Armees.; 3: No. 5, 383-392 (1975). (In French).

After having defined the kind of hazard due to internal exposures to radionuclides, the main characteristics of the metabolism of the most radiotoxic radionuclides are briefly pointed out. An essential notion results from those data: the need of an early treatment. A model of kits that should permit to apply such an emergency treatment is proposed. (FR)

**12451** RADIOTOXICOLOGICAL SURVEILLANCE OF INTERNAL CONTAMINATIONS BY LABELLED THYMIDINE FROM THE SPECIFIC ACTIVITY OF URINARY $\beta$ AMINO-ISOBUTYRIC ACID.

Geronimi, C. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service Medical du Travail); Jockey, P. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection); Tellier, N. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Surete Nucleaire). pp 85-104 of Seminaire de Radiobiologie sur la Contamination Radioactive Interne. Jarry, H. (ed.). Montrouge, France; Societe Francaise de Radioprotection [nd]. (In French)

From radiobiological seminar on internal contamination; Paris, France (18 Mar 1974). Also published in Radioprotection (74), v. 9(2), p. 93-110.

A compartmental model has been established from selected literature in the case of thymidine internal contamination. It has been checked by pig experiment. Due to degradation of thymidine before excretion, bioassay is based on determination of $\beta$ amino-isobutyric-acid urinary specific activity. In case of a heavy human contamination the model would have to be personalized from the subject's own excretion curve. Peculiar aspects of the dosimetric problem are evocated. (FR)

**12452** $^{90}$Sr IN BONES OF THE CZECHOSLOVAK POPULATION FROM 1964 TO 1969. Brezik, Z. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia)); Kunz, E. (Institut Hygieny a Epidemiologie, Prague (Czechoslovakia). Ustav Hygieny Zareni). Cas. Lek. Cesk.; 112: No. 24, 750-754(15 Jun 1973). (In Czech).

During 1964 to 1969, the content of $^{90}$Sr and Ca was systematically examined in the bones of the deceased of various age. The concentration of $^{90}$Sr in relation to Ca showed a significant age dependence. This change was most markedly reflected by $^{90}$Sr deposition in the bones of babies and infants. The average dose from $^{90}$Sr deposited in human bones from radioactive fallout did not exceed 10 to 15 mrad per annum in the years of maximum fallout, and represented but a small fraction of the background dose. (auth)

## Animals

*Refer also to abstract 12448.*

**12453** (CEA-R-4706) EFFECTS OF VARIOUS ECOLOGICAL FACTORS ON RADIOSTRONTIUM UPTAKE IN TWO EURYHALINE TELEOSTS: MUGIL AURATUS RISSO AND PLEURONECTES PLATESSA L. Amiard, J. C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service de Recherches Toxicologiques et Ecologiques). Nov 1975. 70p. (In French). Dep. NTIS (US Sales Only) $5.50.

The effects of various ecological, biotic, and abiotic factors (age, species, salinity, temperature, sediment, calcium overload, food) on the accumulation of $^{85}$Sr were studied in two euryhaline Teleosts. Generally, all the physico-chemical and biotic factors tending to activate metabolism, slightly increased radiostrontium intake. Concentration factors were seldom above one for animals measured in toto. According to the concentration kinetics of $^{85}$Sr, three types of organs were distinguished: bone-type tissues, soft tissues, and digestive tract. (auth)

**12454** NATURE OF RADIATION CONDITIONS IN THE DEVELOPMENT OF EGGS OF FRESHWATER FISH BELONGING TO VARIOUS ECOLOGICAL GROUPS. Pityanen, G. B.; Zaitsev, Yu. A. (Biophysics Inst., Moscow). Sov. J. Ecol. (Engl. Transl.); 5: No. 6, 566-568(1974).

Translated from Ekologiya; 5: No. 6, 73-75(1974).

Studies were conducted to estimate the dose produced by $^{90}$Sr and $^{137}$Cs in fish eggs developing under natural conditions. The following data were used for dose estimation; $^{90}$Sr and $^{137}$Cs accumulated by egg contents; $^{90}$Sr and $^{137}$Cs absorbed by egg covering; $^{90}$Sr and $^{137}$Cs dissolved in water; and $^{90}$Sr and $^{137}$Cs absorbed by lake bottom sediments. Results are tabulated and discussed. (HLN)

**12455** BEHAVIOR OF RADIOISOTOPES OF STRONTIUM AND CESIUM IN MODEL BIOGEOCENOSES. Gegamyan, G. V. (Inst. of Medical Radiology, Obninsk, USSR). Sov. J. Ecol. (Engl. Transl.); 5: No. 6, 586-589(1974).

Translated from Ekologiya; 5: No. 6, 91-93(1974).

Experiments were conducted to study the behavior of $^{90}$Sr and $^{137}$Cs under conditions approximating a natural situation. Boxes containing soil from bottom land meadows were set up and grass mixtures were planted. Several species of mosses were planted in some of the boxes. Radioisotopes were introduced in aqueous solution. Three weeks later samples of soil and underground parts of plants were analyzed. Results showed that plant cover exerted a strong influence on radioisotope distribution in the soil. Mosses exerted a stronger influence than grasses. (HLW)

**12456** PROTEIN BOUND RADIOACTIVITY IN NEURONAL AND GLIAL FRACTIONS FOLLOWING INTRA-CAROTID $^{3}$H-LEUCINE PERFUSION. Blomstrand, C.; Hamberger, A.; Sellstroem, A.; Steinwall, O. (Univ., Goteborg). Neurobiology; 5: 178-187(1975).

Brain proteins in one cerebral hemisphere were labeled by means of intracarotid perfusion with $^{3}$H-leucine by a 40 s pulse. Recirculating percursor contributed little to the protein bound radioactivity. This radioactivity reached a peak level 30 min after perfusion. Fractions enriched in neuronal perikarya and glial cells showed a similar time course of labeling, but the neuronal fraction demonstrated the highest level of protein bound radioactivity. Subcellular fractions from whole brain were studied by the same system. The highest protein bound radioactivity was observed in the nuclear and microsomal fractions. The brain entry of the precursor by means of a controlled intracarotid pulse of short duration offers particular advantages in short-term experiments since the systemic metabolism of the labeled precursor is largely avoided. The easily achieved high labeling of proteins facilitates assay of the radioactivities in different cellular and subcellular fractions and also allows analyses of relative turnover rates in electrophoretically separated proteins. (auth)

**12457** STUDY OF ZINC TOXICITY FOR THE SHRIMP PALAEMON SERRATUS PENNANT. Fraizier, A. (CEA Centre de La Hague, 50- Cherbourg (France). Service de Recherches Toxicologiques et Ecologiques). Rev. Trav. Inst. Peches Marit.; 37: No. 2, 291-302(Jun 1973). (In French).

An experimental pollution of shrimps by stable zinc ($ZnCl_2$) during 30 d. allowed to determine the lowest amount (1 mg/l) in sea water leading to high lethality. The kinetics of Zn uptake were studied using $^{65}$Zn. Zn retention seemed to result mainly from adsorption processes and acute pathological effects from flocculation of the branchial mucus leading to death by asphyxiation. (FR)

**12458** EXPERIMENTAL STUDY OF CONTAMINATION BY CERIUM-144 AND IRON-59 OF A SEDIMENT WITH ARENICOLA MARINA. Amiard-Triquet, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service de Recherches Toxicologiques et Ecologiques). Cah. Biol. Mar.; 15: 483-494 (1974). (In French).

Cerium-144 and $^{59}$Fe are introduced in seawater in soluble form and give rapidly particulate forms. In this state, they are very rapidly sorbed in the superficial sediment. This sorption will involve an important decontamination of seawater. It does not seem possible that Arenicola could concentrate $^{144}$Ce and $^{59}$Fe sorbed in the sediment. The burrowing activity of the worms conducts to homogenize the repartition of $^{144}$Ce and $^{59}$Fe in the sediment. (FR)

**12459** DISTRIBUTION OF RADIOACTIVITY IN THE TISSUES OF SHEEP GIVEN $^{75}$Se-SELENOMETHIONINE. Hidiroglou, M.; Jenkins, K. J. (Ministry of Agriculture, Ottawa (Canada). Animal Research Inst.). Ann. Biol. Anim. Biochim. Biophys., B; 14: No. 4, 837-844(1974). (In French).

Oral and intravenous doses of $^{75}$Se-selenomethionine were given to 30 sheep in the proportion of 5.5 $\mu$Ci per kg of live weight. These animals were slaughtered at 3, 5, and 24 hours after isotope administration. Ten sheep were used at each of the intervals mentioned. Maximum radioactivity was obtained in the tissues 24 hours after oral administration, and 3 and 5 hours after intravenous (IV), the latter doses being stronger than the former. Highest labeling was observed in some tissues having high protein synthesis, such as the pancreas. Plasma radioactivity, higher than that of the erythrocytes, was noted more often after IV than after oral administration. Most of this radioactivity was incorporated in proteins. Radioactivity measurements of whole blood showed that during the first 30 minutes following intravenous injection of the isotope, there is a sudden drop, then a rise reaching a peak of radioactivity at 60 minutes, followed again by a gradual and continuous decrease. (FR)

**12460** EFFECT OF ACIDOGENIC DIET ON BONE METABOLISM IN RATS. $^{85}$Sr Investigation. Krcek, L. (Universita J. E. Purkyne, Brno (Czechoslovakia). Lekarska Fakulta). Cas. Lek. Cesk.; 112: No. 19, 589-594(11 May 1973). (In Czech).

The effect was studied in rats of an acidogenic diet on changes in the accumulation of $^{85}$Sr in the rapidly exchangeable fraction of the bone tissue. The accumulation was investigated 2, 5, and 8 weeks after the four-week long acidogenic diet. It was found to vary with the time interval since the end of the diet. The changes could be divided in three stages, viz. an initial decrease, followed by an increase exceeding the level found in the controls, and finally a decrease levelling up at a level slightly below the values for the control animals. The intensified accumulation was believed

to be a manifestation of an enhanced mineral deposition in the Haversian system, previously demineralized by the diet. (auth)

**12461** POTASSIUM DISTRIBUTION AND GLYCOGEN METABOLISM DURING MUSCLE EXERCISE IN RAT. I. Relationships of $^{42}K$ and Glycogen. Vajcikova, H. (Komenskeho Univerzita, Martin (Czechoslovakia). Lekarska Fakulta). Bratisl. Lek. Listy; 62: No. 4, 489-495(Oct 1974). (In Czech).

The radioisotope method was employed in the investigation of the $^{42}K$ incorporation in the muscle, liver, erythrocytes, and blood plasma of rats at rest and during muscle exercise. At rest, the highest $^{42}K$ activity was found in the muscle and the liver, decreasing via the erythrocytes to the plasma. Following exercise, a decreased activity could be observed in the liver, the muscle, and the erythrocytes, while an increased activity was found in the plasma, this as a result of the cellular $^{42}K$ passage to the plasma volume. A direct quantitative relationship between the $^{42}K$ activity and the amount of glycogen in the muscle and in the liver was found to exist both in the controls and in the experimental animals following muscle exercise. (auth)

**12462** EFFECT OF STABLE STRONTIUM ON THE INCORPORATION AND METABOLISM OF RADIOACTIVE STRONTIUM IN YOUNG AND ADULT RABBIT BONES. Witkowska, D. (Inst. of Occupational Medicine, Lodz, Poland). Acta Physiol. Pol.; 26: No. 4, 407-418(1975).

The experiments were performed on 5-, 8-, 12-, and 14-months old rabbits. The effect of stable strontium enriched diet on the bone tissue formation (apposition) and on physicochemical processes consisting in ion exchange were studied using radioactive isotopes, Sr-85 and Ra-226 and tetracycline. The results of kinetic and autoradiographic studies and micoscopical analysis of bone preparations suggest that stable strontium inhibits the mineralization of newly formed bone tissue without affecting the physicochemical processes related to ion exchange. (auth)

**12463** SOME REGULARITIES IN THE METABOLISM OF $^{106}Ru$ IN PIGS. Burov, N. I.; Sarapul'tsev, I. A. S-kh. Biol.; No. 1, 114-118(1974). (In Russian).

The relationship was established for the intensity of uptake of $^{106}Ru$ in the gastrointestinal tract in relation to the age of the animals. Based on the results of radiometric studies an experimental mathematical model was constructed which characterized the accumulation of the isotope in the organs and tissues. (JPRS)

### Plants

*Refer also to abstracts 11486 and 12042.*

**12464** (CONF-7404111-, pp 303-436) ION UPTAKE AND TRANSLOCATION. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Results are reported for the following studies: $^{32}P$ uptake in high temperature-treated rice seedlings of different varieties; kinetic studies on $NH_4-N$ induced uptake of P by maize; effect of salinity and SAR on the growth and uptake of some plant nutrients and translocation of $^{32}P$ by rice; effect of zinc application on uptake and distribution of $^{32}P$ in wheat plants; selenium and phosphorus interaction in peas (Pisum sativum); effect of cations and P on the mobility of $^{65}Zn$ in plants; phosphate nutrition in relation to the uptake and distribution of zinc in maize; effect of dimethyl sulfoxide on uptake and transport of $^{65}Zn$ and $^{32}P$ in relation to root permeability in maize seedlings; Fe-Mn and Zn-Mn interactions in maize seedlings; influence of iron on uptake and transport of zinc in wheat and maize; mechanism of zinc absorption in soybeans; Mn absorption in rice (Oryza sativa): kinetics and interactions with divalent cations; relationship between N, P, K deficiency and crop yield; uptake and transport of solutes; and foliar leaching and retention of Ca, Sr, and Ra. (HLW)

**12465** (CONF-7404111-, pp 717-831) PHOTOSYNTHESIS. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

The following studies were conducted; photosynthesis in some bryophytes; effect of NaCl concentration on carboxylation enzymes in the marine alga, Enteromorpha tubulosa; carbon metabolism and carboxylating enzymes in Ulva lactuca; translocation of $^{14}C$ photosynthates in rice; pattern of photosynthesis in saline indica variety of rice; and photosynthetic and metabolic role of different non-leaf green tissues of plants. (HLW)

**12466** AERIAL UPTAKE OF $^{210}Po$ BY PLANTS ON PLOTS WITH AN ELEVATED RADIUM CONTENT. Popova, O. N.; Taskaev, A. I.; Testov, B. V. (Inst. of Biology, Komi, USSR). Sov. J. Ecol. (Engl. Transl.); 5: No. 6, 522-526(1974).

Translated from Ekologiya; 5: No. 6, 22-28(1974).

The characteristics of the aerial uptake of $Po^{210}$ by plants was studied under experimental conditions simulating areas with an increased natural radiation background. It was shown that the distribution of $Po^{210}$ in individual foliage organs was correlated with size and surface character and depended on the radionuclide content in the air and on the time for which the aerial portions of the plants were in contact with the ambient air. (auth)

**12467** $^{210}Po$ IN TOBACCO AND TOBACCO PRODUCTS IN SLOVAKIA. Abel, E.; Sladkova, M.; Uralova, M. (Vyskumny Ustav Hygieny, Bratislava (Czechoslovakia)); Huszar, J. (Vyskumny Ustav Tabakoveho Priemyslu, Bab (Czechoslovakia)). Cesk. Hyg.; 19: No. 10, 475-479(Dec 1974). (In Slovak).

The content of $^{210}Po$ in various kinds of tobacco and tobacco products grown or processed in Slovakia was investigated. The results indicate that different kinds of tobacco and different quality classes have a different cumulative ability. The average $^{210}Po$ activity in pipe tobacco was 1.1 pCi per gram and in cigarettes 0.43 pCi per cigarette. The importance of a complex evaluation of the bioengineering role of not only $^{210}Po$, but also of other volatile radionuclides in tobacco smoke such as $^{228}Th$, $^{137}Cs$ and others, is pointed out. (auth)

## New Tracer Techniques

*Refer also to abstracts 11424, 12094, 12311, and 12369.*

**12468** (CEA-R-4710) COMPARATIVE STUDY OF ISOTOPIC AND NONISOTOPIC METHODS FOR RESPIRATORY FUNCTION EXPLORATION. Roy, M.; Brenot, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). Dec 1975. 49p. (In French). Dep. NTIS (US Sales Only) $5.00.

A group of patients with unilateral pulmonary restrictive disease was studied using numerous clinical, functional, and isotopic examinations to state their respiratory function following a pleural puncture-biopsy. Statistical multivariate analysis methods are helpful to describe with simplicity those patients and to follow their prognosis. They also provide mutual comparison between the three exploration types and decision for suppressing possible redundant measures. Some examinations are lacking for some patients, but this statistical technique is strong enough to permit some incomplete data. (auth)

**12469** (CONF-7209130-, pp 159-168) $^{18}O$ IN ECOLOGY: ITS USE FOR MEASURING ENERGY METABOLISM IN FREE-LIVING ANIMALS. Mullen, R. K. (EG and G, Inc., Goleta, CA). 1972.

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

A review is given of the laboratory and field development of the use of deuterium and $^{18}O$, or the $D_2{}^{18}O$ method, for the measurement of the energy metabolism of wild animals. The five simplifying assumptions made in using the method in natural habitats are outlined and the errors contributed by each are discussed. Practical limitations to the method such as cost and amount of field work are briefly considered. (JSR)

**12470** (CONF-7209130-, pp 175-188) ORIGIN OF PHOTOSYNTHETIC OXYGEN. Gerster, R.; Dupuy, J.; de Montgareuil, P. G. (CEN, Cadarache, France). 1972. (In French)

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

From the comparison of isotopic exchange kinetics between $C^{18}O_2$ and the water of algae suspensions or aerial leaves subjected to alternating darkness and light, it becomes possible to calculate the isotopic abundance of the $CO_2$ involved in the photochemical process; this value has been compared to those of the intracellular water and of the evolved $O_2$. Kinetics of the appearance of $^{18}O$ in the oxygen produced by algae suspended in enriched water are also presented. (auth)

**12471** (CONF-7209130-, pp 231-237) MEASUREMENT, BY MEANS OF $CO_2$ ENRICHED IN $^{13}C$ AND $^{18}O$, OF THE ISOTOPIC EFFECTS DURING PHOTOSYNTHETIC FIXATION OF $CO_2$. Gerster, R. (CEN, Cadarache, France). 1972. (In French)

From proceedings on oxygen isotopes; Cadarache, France (4 Sep 1972).

In proceedings of an international colloquium on oxygen isotopes.

The use of $^{13}C$ and $^{18}O$ enriched $CO_2$ allows to measure with accuracy isotopic effects, related to the carbon atoms, occuring during the diffusion of carbon dioxide between two phases. Photosynthesis experiments performed with algae suspensions (Euglena gracilis) or aerial leaves (Saccharum officinale, Lycopersicum esculantum, Platanus orientalis, Sinapis alba ...) have led to the determination of an isotopic discrimination factor between $^{12}C$ and $^{13}C$ very close to 1. The method can be applied to the study of isotopic effects in enzymatic reactions involving $CO_2$. (auth)

**12472** (CONF-7404111-, pp 437-568) FERTILIZER USAGE. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

Results are reported for the following studies: utilization of fertilizer phosphorus in rice-wheat cropping sequence of different soils; tracer studies on phosphorus utilization by direct sown rice under upland condition; relative efficacy of different methods of $^{32}P$ application on fertilizer P uptake by maize (Zea mays); tracer investigations on the effect of graded doses of P application in relation to cycocel spray on uptake and utilization of P in American cotton (G. hirsutum); evaluation of ammonium nitrate phosphates; relative efficiency of different citrate and water soluble nitrophosphates tagged with $^{32}P$ on Bihar soils and paddy as the test crop; evaluation of $^{32}P$-labeled ammonium nitrate phosphates varying in water solubility-maize and bajra fertilization; efficiency of nitrophosphates of varying water solubility with respect to their $^{15}N$ and $^{32}P$ utilization; relation of zinc levels and water soluble P in suphala on uptake of P and Zn; efficiency of phosphate fertilizers in alluvial soils; behavior of ammonium pyrophosphates in the soil-plant system; zinc-phosphorus interactions in wheat and paddy production under field conditions; tracer studies on the efficiency of applied sulphur and its utilization by berseem (Trifolium alexandrium) grown in soils of M.P.; and contribution of sulphur absorbed from gypsum in nutrition of soybeans. (HLW)

**12473** (CONF-7404111-, pp 569-662) ROOT DISTRIBUTION IN RELATION TO NUTRIENT UPTAKE. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

The following studies were conducted: root distributions study of rice varieties by $^{32}P$ injection technique under soil moisture deficit; root activity of high yielding varieties of rice; root distribution pattern and nitrogen uptake of wheat germplasms in relation to rates and methods of nitrogen application; rooting pattern of wheat in relation to nitrogen level; rooting behavior of maize under normal and adverse soil conditions; root distribution of barley; $^{32}P$ tracer studies of sugar cane rooting pattern; and comparison of soil excavation and $^{32}P$ tagging methods for studying rooting pattern. (HLW)

**12474** (CONF-7404111-, pp 663-715) PLANT METABOLISM. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of raidations and radioisotopes in studies of plant productivity.

The following studies were conducted: pattern of $^{32}P$ incorporation in DNA and RNA by rootforming hypocotyl cuttings of Vigna; nucleic acid metabolism in inoculated and uninoculated Phaseolus roots during development; nitrogen uptake, RNA and protein synthesis in high protein genotypes of rice; metabolism of sucrose and changes in some key enzymes during grain development in paddy; movement of organic substances from the host to the root parasite Santalum album; and uptake and translocation of $^{45}Ca$ and $^{32}P$ by angiospermic root parasite Santalum album and by one of its host plants, Dolichos lablab. (HLW)

**12475** (CONF-7404111-, pp 833-859) METABOLISM AND DEGRADATION OF PESTICIDES. 1974.

From symposium on use of radiations and radioisotopes in studies of plant productivity; Pantnagar, India (12 Apr 1974).

In use of radiations and radioisotopes in studies of plant productivity.

The following studies were conducted: translocation and persistence of some labelled fungicides in wheat; effect of rice straw on the degradation of $^{14}C$-parathion in flooded alluvial soil; metabolism of $^{14}C$-lindane in flooded alluvial soil; and degradation of thiram in soil. (HLW)

**12476** (COO-3333-11) ACQUISITION, PROCESSING AND DISPLAY OF GATED CARDIAC SCINTIGRAMS. Alpert, N. M.; Chesler, D. A.; McKusick, K. A.; Potsaid, M. S.; Pohost, G. M.; Dinsmore, R. A. (Massachusetts General Hospital, Boston (USA). Radiology Dept.). 1974. Contract AT(11-1)-3333. 4p. (CONF-740531-1). Dep. NTIS $4.50.

From 4th symposium on sharing of computer programs and technology in nuclear medicine; Oak Ridge, Tennessee, USA (8 May 1974).

An improved method for non-traumatic and essentially non-invasive evaluation of left ventricular (LV) function with /sup 99m/Tc as the tracer was developed. This method combines previously used EKG gating techniques for cardiac blood pool visualization with new computerized acquisition, processing and display techniques. An Anger camera, a small computer, and a physiological synchronizer are used to acquire a sequence of eight scintigrams which span the entire cardiac cycle. Under our present protocol two twenty-minute sequences are obtained, one an LAO ($50^0$) projection, the other an RAO ($30^0$) projection. Subsequently these images are processed on-line with a digital filter to increase definition of the cardiac borders. The eight images are then displayed sequentially on a specially designed electronic monitor to give an impression of the beating heart somewhat analogous to that obtained with invasive contrast angiography. (auth)

**12477** (INIS-mf-1632, pp 18-37) METABOLISM OF PROSTAGLANDIN F2$\alpha$ IN FEMALE SUBJECTS. Granstroem, E. 1972.

From 3rd conference on prostaglandins in fertility control; Stockholm (17 Jan 1972).

In prostaglandins in fertility control. (Kungliga Karolinska Mediko-Kirurgiska Institutet, Stockholm (Sweden)).

This study was undertaken to investigate biological inactivation mechanisms of prostaglandin $F_{2\alpha}$ and to identify metabolic end products in urine. Furthermore, intermediates appearing in plasma after administration of $PGF_{2\alpha}$ have been identified and preliminary kinetic studies have been carried out. The investigation was carried out by radioassay for which the method is described. The prostaglandin was labelled by tritium. (auth)

**12478** (INIS-mf-1745) RADIOGRAPHIC ANALYSIS FOR DETECTION OF INTERNAL INFESTATION IN MAIZE. Carmona, W. G. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). 1974. 187p. (In Spanish). INIS.

An analytical method was established to determine the internal infestation by insects in grains of stored maize. The method is based on an x-ray radiometric technique. The various stages of development of the insects can be determined and identified. The interaction of radiation with matter are analyzed, particularly with respect to the radiography of biological material. In order to establish the radiographic technique a study was made of the factors involved in the process such as the operating characteristics of the x-ray device, geometric factors, variables of the radiography, types and characteristics of films, and auxiliary apparatus needed. (INIS)

**12479** (INIS-mf/1821) COMPETITIVE PROTEIN-BINDING AND RADIOIMMUNOASSAY OF VITAMIN B12 IN SERUM. van de Wiel, D. F. M. (Rijksuniversiteit Groningen (Netherlands)). 25 Sep 1974. 105p. INIS.

Thesis.

Three methods for the measurement of vitamin B12 by means of saturation have been investigated. The pooled serum method is based on pooled human serum as the source of binding protein. Separation of free from bound vitamin B12 is obtained by adsorption of the bound vitamin to DEAE-cellulose, followed by filtration. The unknown serum is extracted with glutamic acid pH 4.3 by which procedure centrifugation is avoided. In the bacteria method vitamin B12 is bound by a protein from the cell wall of Lactobacillus leichmannii. The intact bacteria are used as solid phase. Separation of free from bound vitamin is obtained by filtration in a disposable syringe. The antibody method is the first radioimmunoassay of vitamin B12 that has been reported. Antibodies were purified by rivanol and identified by polyacrylamide gel electrophoresis. Affinity chromatography proved to be a useful method for purification of the antibodies. (INIS)

**12480** DUAL ISOTOPE SCINTISCAN. New Method for Evaluating Bladder Function. Lipshultz, L. I.; Corriere, J. N. Jr. (Univ. of Pennsylvania, Philadelphia). Urology (Ridgewood, N. J.); 4: No. 3, 267-270(Sep 1974).

Technetium-99m radioactive colloid particles were suspended in an iodine-131 Hippuran radioactive fluid medium and placed into the bladders of six patients. Two normal patients and one with only one urinary tract infection voided the fluid and particles synchronously, while three with recurrent urinary tract infections eliminated the particles at a much slower rate than the fluid. A change in either the physical contour or secretory activity of the bladder urothelium is postulated as the cause of particle retention in these patients with chronic infections. (auth)

**12481** CLINICAL SIGNIFICANCE OF THE RADIOACTIVE METHODS OF STUDYING THE EFFICACY OF THE RENAL PLASMA FLOW. Minkin, R. B.; Emanuel, V. I. (Leningrad Medical Inst.). Klin. Med. (Moscow); 53: No. 3, 33-41(Mar 1975). (In Russian).

The purpose of the work is comparison of radioactive and nonradioactive methods of determination of the effective renal plasma flow and detection of the significance of this value in a number of the conventional methods of investigations of the renal function in patients with diffuse nephritis, pyelonephritis, and hypertensive disease. Values of the effective renal plasma flow are obtained by the Blaufox–Merrill–Ram and coauthors method, and by the original method for determining a drop in $\beta$-activity of hippuran $^{134}I$ in the capillary blood and by the standard Smith method. In 51 observations a close correlation between the values of the effective renal plasma flow determined by radioactive and nonradioactive methods was noted; In 123 observations a close correlation between the values of the effective renal plasma flow obtained by the Blaufox–Merrill–Ram and coauthors method was established. In 32 observations a close correlation was noted between the values of the effective renal plasma flow determined by the method after Blaufox and Merrill in the regimen of $\gamma$- and $\beta$-spectrophotometry with hippuran $^{131}I$. The method of divergence was used to select the most significant traditional indices of the renal function (residual nitrogen of the blood serum, urea, creatinin, glomerular filtration, canalicular secretion and reabsorption, blood hemoglobin). It appeared that a drop in the effective renal plasma flow takes place at the earliest stages of the disease when conventional chemico-biochemical indices may still preserve their normal values. (auth)

**12482** EVALUATION OF NORMAL MYOCARDIAL PERFUSION BY MEANS OF SCINTIGRAPHY AND SELECTIVE CORONARY ANGIOGRAPHY. Felix, R.; Majumdar, A.; Majumdar, D. (Univ., Cologne). Indian J. Chest Dis.; 16: No. Suppl., 322-324 (Sep 1974).

The synoptic interpretation of imaging techniques by coronarography, myography, and perfusion scintigraphy provides satisfactory evidence of anatomical topographical details. These findings cannot be obtained with other external counting methods or with a single one of the above-mentioned techniques as each of these methods has well known limitations. Furthermore, using myography and perfusion scintigraphy, the regional distribution of perfusion in the terminal blood stream can be evaluated. Because of the spheric shape of the heart the interpretation of the myogram and the perfusion scintigram may be difficult to delineate. An exact analysis of the normal conditions is therefore essential before pathological descriptions can be reviewed. The image that embodies the most information about the perfusion relations of the left ventricle in scintigraphy and myography is obtained in the second anterior oblique view. For the right ventricle the scintigraphical and myographical imaging is optimal in the first anterior oblique view. Topographical relations are explored in detail. According to the data published and from our own experiences the safety of perfusion scintigraphy by intra-coronary injection of the material has been firmly established in man presuming an adequate dose of particles had been administered. After application of a single dose of radionuclide, images can be obtained in various views of scintigraphy and coronarography techniques. (auth)

**12483** CONTRIBUTION OF ISOTOPE ANGIOCARDIOGRAPHY WITH THE USE OF SCINTILLATION CAMERA FOR EXAMINATION OF PATIENTS WITH MEDIASTINAL EXPANSIVE PROCESSES. Kuchar, O.; Krc, I.; Oral, I. Cas. Lek. Cesk.; 113: No. 17, 514-516(1974). (In Czech).

Diagnostic possibilities of the isotope angiocardiography with the use of scintillation camera in investigation of patients with expansive disease involving upper mediastinum are discussed. After administration of radiumpertechnate bolus into the right antecubital vein the course of changes in radioactivity was recorded on videorecorder and displayed on persistent oscilloscope. With this procedure impairments of blood flow through superior caval vein from slight stenosis to obstruction were demonstrated and moreover it was possible to determine their localization, extent and haemodynamic significance. Four observations are presented (slight stenosis, moderate stenosis, severe stenosis and obstruction of vena cava sup.). (auth)

**12484** EVALUATION OF SYNOVITIS ACTIVITY BY $^{99m}$Tc-PERTECHNETATE USING THE GAMMAGRAPHIC METHOD. Makalova, I.; Makal, F. (Fyziky a Nuklearnej Mediciny, Bratislava). Bratisl. Lek. Listy; 63: No. 1, 18-24(1975). (In Czech).

The authors describe a method of visualization in nuclear medicine suitable for objective determination of the stage of synovitis, performed by intravenous administration of $^{99m}$Tc-pertechnetate that accumulates to a great extent in the inflammed joint. The procedure is convenient for an early diagnosis of synovitis, for the determination of its degree and extent, and for following up therapeutic success. In spite of its nonspecificity, the method is a valuable contribution in evaluating synovitis. (auth)

**12485** ASSESSMENT OF REGIONAL VENTILATION BY CONTINUOUS INHALATION OF RADIOACTIVE $^{81m}$Kr. Fazio, F.; Jones, T. (Hammersmith Hospital, London). Br. Med. J.; 3: No. 5985, 673-676(20 Sep 1975).

A simple technique is described for producing high-quality functional images of regional ventilation during physiological tidal breathing of the inert gas $^{81m}$Kr. These images were quickly obtained on a gamma camera without the need of computerized systems for data acquisition and display and were directly comparable with those of perfusion obtained with $^{99m}$Tc-labelled macro-aggregates. The short time required for the procedure, its simplicity, and the extremely low absorbed-radiation dose enabled serial images of ventilation to be obtained in multiple views. (auth)

**12486** ULTRASENSITIVE RADIOIMMUNOASSAY FOR DIRECT DETERMINATION OF FREE TRIIODOTHYRONINE CONCENTRATION IN SERUM. Weeke, J.; Oerskov, H. (Kommunehospitalet, Aarhus, Denmark). Scand. J. Clin. Lab. Invest.; 35: No. 3, 237-244(May 1975).

Free triiodothyronine ($T_3$) in serum has been measured directly in dialysates of serum, using a wick chromatographic radioimmunoassay. Adequate sensitivity was attained by the use of [$^{125}$I]$T_3$ with a very high specific activity (2,000 to 3,000 $\mu$Ci/$\mu$g). Sera were dialysed against a Krebs–Ringer bicarbonate buffer modified so as to be similar to plasma water. Dialysis took place under carefully controlled circumstances. The influence on the equilibrium of total to free $T_3$ of temperature, serum dilution and dialysis time was studied. By the present method, free $T_3$ in serum from groups of subjects including 20 men, 10 women taking oral contraceptives and 20 women with normal menstrual cycles were identical, averaging 5.2 pg/ml. A chromatographic radioimmunoassay of total $T_3$ using high specific activity [$^{125}$I]$T_3$ and a very small test sample is also described. (auth)

**12487** HETEROGENEOUS NUCLEAR RNA FROM LYMPHOCYTES OF CHRONIC LYMPHOCYTIC LEUKEMIA: ADENYLATE-RICH AND DOUBLE-STRANDED REGIONS. Maansson, P. E.; Holmquist, L.; Deutsch, A.; Norden, A. (Lund Univ., Sweden). Scand. J. Haematol.; 14: 42-56(1975).

Rapidly labelled high molecular weight nuclear RNA from lymphocytes of chronic lymphocytic leukemia was analyzed for ribonuclease-stable adenylate-rich and double-stranded regions. The polyadenylate content corresponds to 0.4 to 0.5% and the content of double-stranded sequences to 2 to 4% of the total nucleotides. Partial association of polyadenylate segments with double-stranded regions was found by comparative analysis of ($^3$H)-adenosine and ($^3$H)-uridine labelled ribonuclease-stable RNA before and after thermal denaturation. Comparison with normal lymphocytes shows lower proportions of polyadenylate-containing RNA binding to poly(U)-Sepharose in leukemia cells than in normals. Partial degradation of rapidly labelled high molecular weight RNA was found in leukemia cases with low white cell counts. (DA)

**12488** FRACTIONATION OF PROTEIN CARRIED BY AXOPLASMIC TRANSPORT. II. Comparison in the Rat of Proteins Carried to the Optic Relay Nuclei. Siegel, L. G.; McClure, W. O. (Univ. of Illinois, Urbana). Neurobiology; 5: 167-177(1975).

Proteins carried in the fast (200 mm/day) axoplasmic flow of retinal ganglion cells in albino rats were labeled with intraocular injections of radioactive L-methionine. Transported proteins which accumulated in the lateral geniculate nuclei (LGN) and superior colliculi (SC) 4½ hours after injection were extracted with media of increasing solubilizing power. Over 70 percent of the transported material is soluble only in media possessing detergents such as Triton X-100 and sodium dodecyl sulfate. Specific activities of the transported proteins exceeded 7000 dpm/mg. With specific activities this high, further fractionation could be carried out under conditions of high resolution. Separations of solubilized proteins on polyacrylamide gels, either with or without detergents, showed that a large number (60–100) of polypeptides are transported. Using a double labeling procedure which employed L-[$^{35}$S]methionine and L-[methyl-$^3$H]methionine, material transported to the LGN was compared with that transported to the SC. No statistically significant differences were seen in the polypeptides transported by the retinal ganglion cells to the two major optic relay nuclei. (auth)

**12489** DYNAMIC, TEMPERATURE-SENSITIVE ASSOCIATION OF $^{125}$I NERVE GROWTH FACTOR IN VITRO WITH GANGLIONIC AND NONGANGLIONIC CELLS FROM EMBRYONIC CHICK. Norr, S. C.; Varon, S. (Univ. of California, San Diego). Neurobiology; 5: 101-118(1975).

$^{125}$I-NGF was found to associate with embryonic chick dorsal root ganglia (DRG) through two processes. A time-saturable process included the binding of NGF to surface receptors with an apparent affinity constant in the range of $10^7$ $M^{-1}$ and at a level of 4 f moles/$\mu$g tissue protein. The second process was time-linear, temperature-sensitive, and included both bound and non-competable NGF. While metabolic inhibitors had little effect, histone and insulin considerably increased the uptake. A comparison of $^{125}$I-NGF and $^{125}$I-peroxidase uptake suggested that the time-linear uptake of $^{125}$I-NGF must include only bound NGF and incubation medium. Sequestration of the proteins taken up was indicated by the lack of release of radiolabeled material at 4°C, even in the presence of native proteins. All these characteristics are consistent with an interpretation that DRG cells can take up NGF and other proteins by a pinocytotic process. Similar NGF binding and uptake properties were found to occur in cells from a variety of other embryonic chick tissues. (auth)

**12490** AMINO ACID INCORPORATION INTO BRAIN SUBCELLULAR FRACTIONS IN EXPERIMENTAL ALLERGIC ENCEPHALOMYELITIS. Babitch, J. A.; Blomstrand, C.; Hamberger, A. (Sahlgrenska Sjukhuset, Goteborg). Acta Neurol. Scand.; 51: 211-224(1975).

The in vitro protein synthetic capacity of brain slices from guinea-pigs in the late stage (17 to 18 days post-induction) of experimental allergic encephalomyelitis was increased over that of Freund's adjuvant injected controls, as determined by the rate of ($^{14}$C)-leucine incorporation into both tris-soluble and tris-insoluble proteins. All subcellular fractions prepared from incubated slices showed increased incorporation, with a crude nuclear fraction having the largest increase. Isolated brain mitochondria from EAE animals incorporated more amino acid into protein during the late stage of the disease, while isolated microsomes and "pH 5 enzymes" show decreased amino acid incorporation compared with controls in the late stage of EAE. Polyacrylamide gel electrophoresis of acidic, soluble proteins isolated from ($^3$H)-leucine labeled nuclear or synaptosomal fractions revealed that increases of incorporation were generalized, and not restricted to a few proteins. (auth)

**12491** STUDY ON TRACHEOBRONCHIAL DEPOSITION AND 2-HOUR RETENTION IN RABBITS. Tomenius, L. (Statens Naturaardsverk, Stockholm). Environ. Physiol. Biochem.; 5: 1-7(1975).

Deposition of well-defined test aerosols of polystyrene particles was studied in rabbits. The deposition was estimated in a standardized part of the tracheobronchial tree following free dissection of the bronchial parts. Ten rabbits were exposed to a mixture of two test aerosols of about the same size (6 to 7 $\mu$m) tagged with $^{51}$Cr and $^{46}$Sc, respectively. There were interindividual differences in tracheobronchial deposition but a correlation ($r = 0.98$) between $^{51}$Cr and $^{46}$Sc tagged particles. Eleven rabbits were first exposed to the $^{46}$Sc tagged aerosol and 2 hours later to the $^{51}$Cr tagged aerosol. In this experiment there was also a correlation ($r = 0.74$) between the tracheobronchial deposition of $^{51}$Cr tagged particles and the 2-hour retention of $^{46}$Sc tagged particles. This result together with results from an earlier study indicate that the large interindividual differences in deposition are real and are not caused by differences in exposure technique, or in the aerosols. (DA)

**12492** EFFECT OF ACUTE HYPOBARIC HYPOXIA ON $^{32}$P INCORPORATION INTO PHOSPHOLIPIDS OF ALVEOLAR SURFACTANT, LUNG, LIVER, AND PLASMA OF RAT. Chander, A.; Viswanathan, R.; Venkitasubramanian, T. A. (Delhi Univ.). Environ. Physiol. Biochem.; 5: 27-36(1975).

Exposure of adult rats to hypobaric hypoxia caused hypolipidemia, hypotriglyceridemia, and hypophospholipidemia. Hypobaric hypoxia produced an increase in liver triglyceride and cholesterol levels and a decrease in lung triglyceride, total phospholipid, and phosphatidyl choline. The proportion of phosphatidyl choline in the pulmonary surfactant fraction I phospholipids (responsible for reducing surface tension) decreased (55.2% as compared to 80.4% in control animals). Incorporation of $^{32}$P into liver phosphatidyl ethanolamine was significantly increased, incorporation into lung phosphatidyl choline and phosphatidyl ethanolamine was increased whereas a decreased incorporation into plasma phosphatidyl choline was observed. The data suggest an enhanced lipid synthesis in liver with a probable impairment of mobilization into plasma. (DA)

**12493** RADIOISOTOPE EXAMINATION OF THE LIVER AND THE BILIARY TRACT AFTER CHOLECYSTECTOMY. Kasatkin, Yu. N.; Rozanov, I. B.; Purizhanskii, I. I.; Moronov, S. P.; Yakushin, V. I.; Khromenkov, V. I.; Sidorchuk, I. I. Khirurgiya (Moscow). 1: 40-42(Jan 1975).

Forty patients were examined at different periods after cholecystectomy. The examinations were conducted using a scintillation gamma-chamber with $^{113m}$In or $^{99m}$Te-labelled radiocolloid or bengal rose. The data permitted evaluation of the state of the reticuloendothelial and polygonal systems of the liver, as well as the degree of compensation of the liver drainage process in various periods after the removal of the gallbladder, and in some cases to precise the level of the biliary tract block. The degree of the functional and morphological alterations was directly proportional to the duration of the lesion and the period of postoperative examination. (auth)

**12494** PLASMA DOPAMINE-$\beta$-HYDROXYLASE IN HUNTINGTON'S CHOREA. Matsson, B. (Umeaa Univ., Sweden); Wetterberg, L.; Ross, S. B. Acta Psychiat. Scand., Suppl.; No. 255, 237-243(1974).

Activity of plasma DBH in a family material containing patients with Huntington's chorea, their healthy siblings, and two samples of control subjects is reported. The activity showed great variation in all groups. An intrafamilial homogeneity occurs indicating that the plasma level of DBH activity is controlled by genetic factors. Differences between healthy siblings and controls are discussed. (auth)

**12495** CATECHOL-O-METHYLTRANSFERASE AND PLASMA MONOAMINE OXIDASE IN PATIENTS WITH AFFECTIVE DISORDERS. Matsson, B.; Mjoerndal, T.; Oreland, L.; Perris, C. (Umeaa Univ., Sweden). Acta Psychiat. Scand., Suppl.; No. 255, 187-191(1974).

COMT-activity in erythrocytes and MAO-activity in plasma were measured in 270 consecutive in- and out-patients of both sexes suffering from different types of affective disorders, and in 70 healthy controls in the age range 20 to 88 years. No significant intergroup differences with respect to either activity were found. Regression coefficients on age, calculated in the healthy controls, were not significant. (auth)

**12496** METABOLISM OF METOPROLOL-($^3$H) IN MAN, THE DOG, AND THE RAT. Borg, K. O.; Carlsson, E.; Hoffmann, K. J.; Joensson, R. E.; Thorin, H.; Wallin, B. Acta Pharmacol. Toxicol., Suppl.; 36: No. 5, 125-135(1975).

The main urinary metabolites of metoprolol-($^3$H) in man, the dog and the rat were identified by gas chromatography and mass spectrometry by comparison with synthesized reference compounds. The amounts of the different metabolites in urine were determined by radio-gas chromatography. In man metoprolol was metabolized by oxidative deamination, O-dealkylation with subsequent oxidation and aliphatic hydroxylation into three main urinary metabolites which together accounted for 85% of the total urinary excretion. In the dog and the rat the same metabolites could be recovered but in different relative abundances. The inhibition of cardiovascular effects of isoprenaline by the metabolites and a presumed metabolite was studied and compared with the effects of metoprolol. Two of the compounds blocked the isoprenaline responses but they were 2 to 8 times less potent than metoprolol. The metabolites showed a significantly lower acute toxicity in mice than metoprolol. (auth)

**12497** PHARMACOKINETICS AND BIOPHARMACEUTICS OF SOME ADRENERGIC BETA-RECEPTOR ANTAGONISTS WITH SPECIAL EMPHASIS ON ALPRENOLOL AND METOPROLOL. Regaardh, C. G. Acta Pharmacol. Toxicol., Suppl.; 37: No. 1, 1-39(1975).

The pharmacokinetic and biopharmaceutical properties of the two adrenergetic beta-receptor antagonists, alprenolol and metoprolol, are reviewed on the basis of results presented in a number of recent investigations. Alprenolol and metoprolol are rapidly and completely absorbed from the alimentary tract, but the first-pass effect of the liver reduces the bioavailability of the orally-administered drug to about 10 (alprenolol) and 50 per cent (metoprolol). The relatively low bioavailability of alprenolol is partly compensated by the formation of 4-OH alprenolol, which significantly contributes to the beta-blocking effect after oral administration of alprenolol. The analyses of the parent drugs were carried out by gas chromatographic and radiometric methods. Tritiated alprenolol and metoprolol were administered orally and radioactivity measured in plasma, serum and urine. (auth)

**12498** CYTOKINETIC ANALYSIS OF OSTEOGENIC CELLS IN THE HEALING PROCESS AFTER FRACTURE. Manabe, S.; Shima, I.; Yamauchi, S. (Kanazawa Univ., Japan). Acta Orthop. Scand.; 46: 161-176(1975).

As the result of cytokinetic analysis of osteogenic cell at the time of reintegration after experimentally administered bone fractures in mice, the following findings were obtained: both mesenchymal-like cells and osteoblasts indicated a reduction of growth fractions 2 weeks later. From these facts, it is considered that in the reintegration of the fracture, these proliferative cells control their own growth fractions according to the necessity of repair of the fractured part. It was argued that chondrocytes

originated from mesenchymal-like cells but should not be the precursors of osteoblasts. It was shown that mesenchymal-like cells must have the potential to differentiate into either osteoblasts or chondrocytes. Mesenchymal-like cells are the precursors of osteoblasts and the latter are the precursors of osteocytes, but mesenchymal-like cells and osteoblasts have their own respective cell cycles. It was argued that the relation between $^{35}S$ uptake by the matrix of the osteoid and chondrocytes as functional cells should be studied in relation to the role played by cartilage tissue in the mechanism of ossification. (auth)

**12499** STUDY OF HEMOLYSIS OF ERYTHROCYTES BY THE METHOD OF RADIOINDICATION WITH $^{51}Cr$ IN CHRONIC DISEASES OF THE LIVER. Akzhigitova, F. N.; Zolotnitskaya, R. P.; Belousova, N. D. (Moscow Medical Inst.). Ter. Arkh.; 46: No. 4, 75-79(1974). (In Russian).

The authors used the method of radioindication with $^{51}Cr$ to investigate 57 patients (44 – with chronic diseases of the liver, 8 with hemolytic anemia, 5 with peptic ulcer). Among 36 patients with liver cirrhosis and chronic hepatitis a significant drop of $T_{\frac{1}{2}}$ $^{51}Cr$(4 to 15 days) was observed in 22. When determining localization of maximum hemolysis there was established mainly a hepatic and hepatico-splenic mechanism of decay of erythrocytes. A correlation between the reduction of the period of semidecay with the enlargement of the spleen, anemia, increased excretion of stercobilin and enlargement of erythroid elements of the bone marrow was noted. In a number of patients shortening of $T_{\frac{1}{2}}$ $^{51}Cr$ was the only sign of increased hemolysis of erythrocytes, this testifying to the presence of the compensated hyperhemolysis of erythrocytes in patients with chronic diseases of the liver. (auth)

**12500** PROLIFERATION AND DIFFERENTIATION OF HEMOPOIETIC AND LYMPHOID TISSUE IN ORGANIC CULTURES (ACCORDING TO $^{3}H$-THYMIDINE INCORPORATION. Luria, E. A.; Prusevich, T. O.; Kolesnikova, A. I. (Inst. of Epidemiology and Microbiology, Moscow). Probl. Gematol. Pereliv. Krovi; 19: No. 11, 13-18(Nov 1974). (In Russian).

With the aid of H-thymidine it was possible to establish some parameters of myeloid and lymphoid cell differentiation. The same cell categories as in the organism were included into the proliferative pool under conditions of organic cultures. In the thymus cells of neonatal mice the time of differentiation of a medium lymphocyte into a small one constituted about 7 hours, of proliferating myeloid cell into a band-form leukocyte in the cultures of the liver of mouse embryos — over 7 and less than 19 hours. The time of maturation from a myelocyte to a metamyelocyte in the human bone marrow cultures constituted about 3 hours, and to a band-form leukocyte — about 9 hours; it took less than 24 and more than 9 hours to mature to a segmentonuclear leukocyte. (auth)

**12501** AUTORADIOGRAPHIC STUDY OF THE NUCLEOLAR RNA METABOLISM DURING THE OOGENESIS OF LINEUS RUBER MUELLER (HETERONEMERTES). Rue, G.; Gontcharoff, M. (Reims Univ., 51 (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 20, 2365-2368(26 May 1975). (In French)

During Lineus ruber oogenesis, there is a very high uridine uptake by the oocyte before the yolk formation. At the end of this stage, the nucleolus shows a special structure that seems to be related to a decrease of the ribosomal RNA synthesis. During the yolk formation, the nucleolus scatters in the nucleus, allowing ribonucleoprotein granules to go towards the cytoplasm. (FR)

**12502** CRITICAL ANALYSIS OF THE GLUTARALDEHYDE FIXATION OF THE THYROID GLAND: A DOUBLE-LABELLING EXPERIMENT. Rognoni, J. B.; Simon, C. (Aix-Marseille-2 Univ., 13 - Marseille (France)). J. Microsc.; 21: No. 2, 119-128(Nov 1974).

Glutaraldehyde is commonly used as fixative for electron microscopy. The loss of iodinated molecules in this fixative was studied in the rat thyroid gland. Glands were sliced in blocks and incubated at 4 deg C in a 2% glutaraldehyde solution. Iodine pools ($^{127}I$) were measured by the isotopic equilibrium method with $^{125}I$ and iodine SRA ($^{131}I/^{127}I$) were calculated after short-term labellings with $^{131}I$. Iodoproteins were separated by precipitation with TCA. Results were compared between two groups of rats adapted to a daily iodine intake of 5 μg (group 5) and 50 μg (group 50), respectively. In the rat thyroid gland fixed with glutaraldehyde: about 5% of the total iodine, essentially in the form of iodoproteins, is solubilized in the fixative whatever the iodine diet of the rat. A preferential solubilization of the youngest molecules of iodoproteins is observed. This preferential solubilization is dependent on the physiological state of the gland since it depends on the iodoproteins turnover. Glutaraldehyde introduces artefacts in the electron radioautographies of thyroid for short-term labelling with iodide. The error introduced is also dependent on the origin of the solubilized molecules of iodoproteins which is discussed. (FR)

**12503** EXTRACTION OF ENDOGENOUS PLASMA TRIGLYCERIDES BY THE WORKING HUMAN FOREARM MUSCLE IN THE FASTING STATE. Olsson, A. G.; Edlund, B.; Kaijser, L.; Carlson, L. A. (Karolinska Sjukhuset, Stockholm). Scand. J. Clin. Lab. Invest.; 35: No. 3, 231-236(May 1975).

The extraction of triglycerides (TG) by the working human forearm was determined in eight healthy fasting men, both by the measurement of chemical arterial-deep venous (a-dv) TG differences and by a-dv differences in TG radioactivity after endogenous labelling with tritiated palmitate. Measurements were made before and then during nicotinic acid infusion. Correction for plasma water shift in the forearm vasculature was made by estimating the [$^{125}I$] albumin activity after an intravenous injection. The overall mean value ± S.E.M. without and with nicotinic acid was for TG arterial concentration (μ mol/l) 713 ± 153 and 695 ± 140, TG a-dv concentration difference (μ mol/l) −14 ± 7 and −6 ± 4, TG arterial radioactivity (cpm/ml) 1650 ± 469 and 1471 ± 342, TG a-dv radioactivity difference 12 ± 24 and −2 ± 13. The average standard errors for the determinations of triglycerides were 0.85% and 1.5% for the chemical and the isotope methods, respectively. In conclusion, no significant average a-dv difference in TG concentration as determined by either the chemical or the isotope method was detected. With the standard errors achieved, however, a-dv differences of less than around 20 μ mol/l could not be discovered. Such an extraction of endogenous plasma TG could, if oxidized, account for about 25% of the oxygen extraction by the exercising forearm. (auth)

**12504** RAPID AND RELIABLE PREPARATION OF MACROAGGREGATED ALBUMIN SUITABLE FOR LUNG SCINTIGRAPHY. Colombetti, L. G. (Loyola Univ., Maywood, IL); Moerlien, S.; Pinsky, S. Int. J. Nucl. Med. Biol.; 2: No. 4, 180-184(Oct 1975).

Published methods for preparing macroaggregates of human serum albumin labeled with $^{99m}Tc$ have been reviewed, and the effects of the variables in these methods studied with the object of developing a standardized technique for the production of a well defined radiopharmaceutical suitable for lung perfusion studies. The effects of varying the experimental conditions of pH, temperature, stirring speed and heating time on the size and hardness of the particles have all been investigated. The tagging efficiencies on labeling with $^{99m}TcO_4^-$, and the proportions of unprecipitated albumin were also determined. The optimum conditions for the preparation of macroaggregates suitable for lung perfusion studies were shown to be pH 6.0, temperature 76 to 78°C heating time 15 min and stirring speed 550 to 650 rev/min. The biological distribution and catabolism of this preparation were studied in dogs. (UK)

**12505** ALTERNATE APPROACH TO THE PREPARATION OF $^{99m}Tc$-SULFUR COLLOID. Noronha, O. P. D.; Sewatkar, A. B.; Ganatra, R. D.; Glenn, H. J. (Bhabha Atomic Research Centre, Bombay). Int. J. Nucl. Med. Biol.; 2: No. 4, 184-185 (Oct 1975).

Technetium-99m sulphur colloid has gained wide acceptance as the choice radiopharmaceutical for scanning the reticuloendothelial system. The labelled colloid particulate matter is accumulated preferentially by the Kupffer cells of the reticuloendothelial system by phagocytosis. Various published methods of preparation of the radiopharmaceutical have been briefly reviewed, and an alternative method described. This method involved the use of minimal yet effective quantities of sodium thiosulphate in the preparation of the colloid, which was stabilized with the polyhydric alcohol mannitol and buffered with sodium citrate. The entire preparation could be completed in the shortest possible time and the product has been used clinically up to 6 hours after preparation. The content of sulphur in the total preparation was less than 0.2 mg/ml. Studies of the biological distribution in mice of the radiopharmaceutical prepared by this technique showed 90 ± 3% uptake of the injected dose in the liver and 2.5 ± 0.5% in the spleen at the time of sacrifice (15 min). A comparison of the organ distribution patterns in mice was used to study the effect of autoclaving the preparation. Only slight differences were detected. This $^{99m}Tc$-sulphur colloid is in routine clinical use for scanning the reticuloendothelial system. (UK)

**12506** INCORPORATION OF RADIOACTIVE LEUCINE AS AN EVIDENCE FOR PROTEIN SYNTHESIS IN LIZARD EPIDIDYMIS. Studies During the Reproductive Cycle and After Testosterone Administration to Intact and Castrated Animals. Gigon, A.; Dufaure, J. P. (Clermont-Ferrand Univ., 63 - Aubiere (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 19, 2241-2244 (21 May 1975). (In French)

Lizard epididymis activity during the reproductive cycle and after testosterone administration results in a marked increase

of radioactive leucine incorporation in vivo and in vitro. The electrophoretic distribution of soluble proteins shows different peaks of radioactivity. Comparison between histological response and pattern of electrophoresis suggests that one of these peaks may correspond to an activity of secretion. (FR)

**12507** RADIOIMMUNOASSAY OF PLASMA CORTICOTROPIN IN THE EDIBLE FROG RANA ESCULENTA L. Vaudry, H.; Leboulenger, F.; Dupont, W.; Vaillant, R. (Rouen Univ., 76- Mont-Saint-Aignan (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 19, 2249-2252(21 May 1975). (In French).

In the green frog (Rana esculenta) the plasma contains a polypeptide immunologically related to human and porcine corticotropins. A radioimmunoassay capable of detecting $4 \cdot 10^{-12}$ g hog ACTH has been used for a direct plasma ACTH assay in the frog. Using this method the ACTH rate was determined both in untreated frogs and in animals under various experimental conditions. (FR)

**12508** URIDINE $^{3}$H-5 AND LEUCINE $^{3}$H-5 UPTAKE IN PLANARIAN CELLS POLYCELIS TENUIS (IIJIMA) CULTIVATED IN VITRO. Franquinet, R.; Le Moigne, A. (Paris-12 Univ., 94- Creteil (France)); Lender, T. (Paris-11 Univ., 91- Orsay (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 19, 2253-2256(21 May 1975). (In French).

RNA and protein synthesis in planarian cells cultivated in vitro was studied by histoautoradiography. In the nondifferentiated cells, uptake of precursor is intense from the beginning of the culture, and sensitive to addition of trophic factors known for their activating effect on mitosis and regeneration. On the contrary the rate of incorporation in differentiated cells is low and uniform, independent of the different factors added to the medium. (FR)

**12509** CONCENTRATION PURIFICATION AND ISOTOPIC MARKING OF VIRUS SIGMA. Bernard, J.; Petitjean, A. M. (Centre National de la Recherche Scientifique, 91- Gif-sur-Yvette (France)). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 19, 2269-2272(21 May 1975). (In French).

Sigma virus has been concentrated by means of polyethyleneglycol and diafiltration; the latter method is more efficient in preserving infectivity. When purified on sucrose gradients, sigma banded in a sharp peak without any polydispersion. Sigma genome was labelled with $^{3}$H-uridine in Drosophile cell cultures. (FR)

**12510** INTERNAL MAMMARY LYMPHOSCINTIGRAPHY. The Rationale, Technique, Interpretation, and Clinical Application: A Review Based on 848 Cases. Ege, G. N. (Princess Margaret Hospital, Toronto). Radiology; 118: No. 1, 101-107 (Jan 1976).

Internal mammary lymphoscintigraphy is a noninvasive reproducible technique which correlates well with the anatomic pattern of lymph node distribution. A study of 848 patients via radiocolloid injection established a normal internal mammary lymph node distribution and detected deviations from this pattern. A review of these cases is followed by a discussion of the clinical application of this technique, especially in carcinoma of the breast. (auth)

**12511** ACUTE CEREBRAL VASCULAR ACCIDENT ASSOCIATED WITH HYPERFUSION. Soin, J. S.; Burdine, J. A. (Baylor Coll., Houston, TX). Radiology; 118: No. 1, 109-112 (Jan 1976).

Cerebral radionuclide angiography can demonstrate decreased or normal radioactivity in the affected region during the arterial phase in patients who have sustained a cerebral vascular accident and thus enhances the diagnostic specificity of the static brain image. In an occasional patient, however, a seemingly paradoxical pattern of regional hyperperfusion with a return to normal or subnormal perfusion following the acute phase has been observed. This phenomenon, called luxury perfusion, has been defined using intra-arterial $^{133}$Xe for semiquantitative cerebral blood flow measurements and should be kept in mind as a potentially misleading cerebral imaging pattern. (auth)

**12512** BRAIN IMAGE MANIFESTATION IN THE PATIENT WITH CAVERNOUS SINUS OCCLUSION. Hahn, F. J. Y.; Schapiro, R. L. (Univ. of Iowa, Iowa City). Radiology; 118: No. 1, 113-114 (Jan 1976).

Radionuclide findings in a case of cavernous sinus occlusion by an intracavernous aneurysm are described. A brain image obtained 10 minutes after injection of $^{99}$Tc-pertechnetate shows diminished activity in the area of the right cavernous sinus and increased activity in the area of the right sylvian veins; these are attributed to abnormal venous blood flow and may serve as a sign of cavernous sinus occlusion. (auth)

**12513** SENSITIVITY AND SPECIFICITY OF /sup 99m/Tc-SULFUR COLLOID LIVER IMAGING IN DIFFUSE HEPATOCELLULAR DISEASE. Geslien, G. E.; Pinsky, S. M.; Poth, R. K.; Johnson, M. C. (Walter Reed General Hospital, Washington, DC). Radiology; 118: No. 1, 115-119(Jan 1976).

The sensitivity and specificity of /sup 99m/Tc-sulfur colloid liver-spleen imaging in diffuse hepatocellular disease and the significance of image patterns found in these diseases are presented. By visually quantifying the image alterations found in biopsy-proven cases of diffuse hepatocellular disease and analyzing the correlation between the histological diagnosis and the quantified image alteration (individually and by groups), the /sup 99m/Tc-sulfur colloid liver-spleen image was found to be highly sensitive (83 percent). Relative discriminatory values were derived for each image finding and a specific image pattern was found in cirrhosis. (auth)

**12514** FOCAL DECREASED SKELETAL UPTAKE SECONDARY TO METASTATIC DISEASE. Vieras, F.; Herzberg, D. L. (Univ. of Arkansas, Little Rock). Radiology; 118: No. 1, 121-122(Jan 1976).

Two cases are reported in which bone imaging with /sup 99m/Tc-labeled phosphate compounds revealed localized areas of decreased uptake corresponding to osteolytic metastases on bone radiographs. These cold bone lesions, although infrequent, should be considered to avoid false negative interpretations. (auth)

**12515** KINETICS OF $HB_s$ ANTIGEN IN MAN. Drouet, J.; Courouce-Pauty, A. M.; Thevenoux, A. M.; Soulier, J. P. (Centre National de Transfusion Sanguine, 75- Paris (France)); Chanard, J.; Vallee, G.; Funck-Brentano, J. L. (Hopital Necker-Enfants-Malades, 75- Paris (France); Institut National de la Sante et de la Recherche Medicale (INSERM), Hopital Necker, 75- Paris (France)). Biomedicine; 22: No. 2, 158-166(Mar 1975).

The metabolism of $HB_s$ antigen had been studied in three human volunteers. One had chronic hepatitis and two were silent carriers. The $HB_s$ antigen had been isolated and purified from the plasma of each of the three subjects and, after iodination, reinjected to the same donor. The parameters of plasma kinetics of $^{131}$I-$HB_s$Ag have been analyzed according to a two compartmental model on the basis of the radioactivity of TCA precipitate (TP) and immunoprecipitate (IP). The fast initial volume of distribution was approximately equal in the three subjects (46.6 ml/kg). The metabolic clearance rate (MCR) of IP was the very same in two subjects but is four times higher in one of the silent carrier. The total renewal time (TRT) was about 3.3 days. Assuming that the $HB_s$ antigen extraction was of the order of 65% the plasma $HB_s$ antigen concentration per liter of plasma would be 12 and 53 mg/liter for two silent carriers and 61 mg/liter for the patient with chronic hepatitis. The radioactive efflux from the model (calculated as IP·MCR multiplied by $HB_s$ antigen concentration) was identical for the two silent carriers and 50% higher in the patient with chronic hepatitis. The increase possibly reflects an increased synthesis of $HB_s$ antigen in the patient with chronic hepatitis. The cumulative urinary radioactivity when added to the whole body counting demonstrated that radioactivity was excreted solely in the urine. The ratio of organ counting to precordium counting did not vary significantly with time in all subjects. (FR)

**12516** BONE MARROW SCAN IN ANEMIAS. Comparison Between $^{99}$Tc Colloids and $^{111}$In-Transferrin. Rain, J. D.; Castro-Malaspina, H.; Dresch, C.; Najean, Y. (Hopital Saint-Louis, 75- Paris (France)). Nouv. Presse Med.; 4: No. 20, 1471-1476 (17 May 1975). (In French)

Thirty-six patients with different types of bone marrow failure have been studied by double scintigraphy, with $^{99m}$Tc-colloids and $^{111}$In-transferrin. The observed results are compared to those obtained by bone marrow biopsy and ferro-kinetic studies. Despite our imperfect knowledge of the physiology of indium, and the non-selectivity of this tracer for the erythropoietic line, the good correlation observed in most cases between scintigraphy with $^{111}$In and ferro-kinetics and bone marrow histology is an argument which favors the clinical use of this tracer. A striking difference between the results of scintigraphy with Tc-colloids and scintigraphy with $^{111}$In was noticed in chronic erythroblastopenias, and in most of the plastic anemias, primitive or due to partial leukemic involvement of the bone marrow. It is suggested that this double study may have an interest for the prognosis in these cases. In patients with lymphoma, treated by radiotherapy and/or chemotherapy, In and Tc scintigraphies show an extension of active bone marrow to normally inactive zones. It indicates a severe defect of the normally active zones, and appears to be a contra-indication for any supplementary chemotherapy. In myeloid metaplasias, this study may be useful for the choice of treatment, by giving precise indications on the degree of splenic erythropoiesis and of bone marrow cellular depletion. (FR)

**12517** EARLY DETECTION OF VENOUS THROMBOSES OF THE LOWER LIMB IN TRAUMATOLOGY USING LABELLED FIBRINOGEN. Pasteyer, J.; Lanata, E.; Bonnard, P.; Jean, N.; Kher, A.; Patel, A. (Centre Hospitalier Universitaire Paris-

Ouest, Hopital Raymond Poincare, 92- Garches (France)). Nouv. Presse Med.; 4: No. 22, 1637-1640(31 May 1975). (In French).

In emergency traumatology, the iodine-125-labeled fibrinogen test is useful in the early detection of phlebitis in patients in whom the routine use of heparin is not possible: fractures of the cervical spine, severe cranial trauma, and elderly subjects. It makes possible the institution of appropriate heparin therapy, without waiting for clinical signs to become evident. Isotopic venous thromboses occurred very frequently and very early and clinical signs, when present (50% of cases), occurred 24 to 48 hours after the appearance of isotopic signs. (FR)

**12518** NUCLEAR MEDICINE: A PRODUCT OF PEACEFUL USES OF ATOMIC ENERGY. Dienstbier, Z. (Karlova Universita, Prague (Czechoslovakia). Fakulta Vseobecneho Lekarstvi). Jad. Energ.; 20: No. 10, 347-349(Oct 1974). (In Czech).

The development of nuclear medicine in Czechoslovakia is surveyed. The organization of nuclear medicine in the country is described and its sphere of interests is defined. (INIS)

**12519** UNUSUAL SCINTIGRAPHIC APPEARANCES OF HOT THYROID NODULES. Ducassou, D.; Gasparoux, S.; Leccia, F.; Latapie, J. L. (Hopital du Haut-Leveque, 33- Pessac (France)); Hughes, A. (Fondation Bergonie, 33- Bordeaux (France)). Nouv. Presse Med.; 4: No. 12, 871-874(22 Mar 1975). (In French).

The classical picture of development of the hot nodule, which takes into account at the same time fixing or non-fixing nature of healthy perinodular tissue and the clinical condition of the patient fails to explain certain biological and scintigraphic findings. Problems related to scintigraphy encountered in the course of the examination are discussed. In 174 stimulation tests carried out, 12 resulted in hypofixation of the isotope in the nodule, scintigraphy being carried out in three patients using $^{99m}TcO_4^-$. Spontaneous reactivation of healthy tissue was seen in five patients. In the light of the cases reported, it would appear that the scintigraphic picture of the hot nodule is more in favor of a duality between the latter and healthy tissue with respect to iodine than of a hypersensitivity to TSH. In the 12 inhibition studies carried out, three showed the persistence of a contralateral shadow. Finally, on five occasions histological examination of the operative specimen showed the presence of neoplastic change, in two cases within the hot nodule. (FR)

**12520** DEGRADATION OF THYROXINE $^{125}I$ IN NORMAL WISTAR AG RATS, ATRICHIS MUTANTS, AND HAIRED HYBRIDS. Zizine, L.; Lefebvres-Boisselot, J. (Ecole Pratique des Hautes Etudes, 75- Paris (France); Centre National de la Recherche Scientifique, 92- Meudon-Bellevue (France). Centre de Recherches sur la Nutrition). C. R. Hebd. Seances Acad. Sci., Ser. D; 280: No. 9, 1103-1105(3 Mar 1975). (In French).

Several experiments conducted in male as well as castrated females rats have shown that the degradation of Thyroxine-$^{125}I$ is much faster in atrichis as compared to haired normal and hybrid. The present study confirms earlier data on the reduced biological half-life of labeled thyroid hormone. (FR)

**12521** RNA SYNTHESIS BY CELLS OR PROTOPLASTS ISOLATED FROM BROADBEAN LEAVES INFECTED WITH BROADBEAN MOTTLE VIRUS. Romero, J. (Faculte des Sciences Agronomiques de l'Etat, Gembloux (Belgium)). Ann. Phytopathol.; 5: No. 3, 225-232(1973). (In French).

Cells or protoplasts isolated from leaves of Vicia faba infected with broadbean mottle virus incorporated specifically uridine-$^{14}C$ into genomic viral RNA, and into an RNA which corresponds to the rapidly-labelled unencapsulated RNA synthesized by leaf tissue of infected broadbean. (FR)

**12522** DNA TURNOVER AND STRAND BREAKS IN ESCHERICHIA COLI. Hanawalt, P.; Grivell, A.; Nakayama, H. (Stanford Univ., CA). pp 47-50 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The extent of DNA turnover has been measured in a dnaB mutant of Escherichia coli, temperature sensitive for semiconservative DNA replication. At the nonpermissive temperature about 0.02 percent of the deoxynucleotides in DNA are exchanged per generation period. This turnover rate is markedly depressed in the presence of rifampicin. During thymine starvation strand breaks accumulate in the DNA of E. coli strains that are susceptible to thymineless death. Rifampicin suppresses the appearance of these breaks, consistent with our hypothesis that transcription may be accompanied by repairable single-strand breaks in DNA. DNA turnover is enhanced severalfold in strands containing 5-bromodeoxyuridine in place of thymidine, possibly because the analog (or the deoxyuridine, following debromination) is sometimes recognized and excised. (auth)

**12523** DEGRADATION OF DUPLEX DNA BY THE recBC DNase OF ESCHERICHIA COLI. Linn, S.; MacKay, V. (Univ. of California, Berkeley). pp 293-299 of Molecular Mechanisms for Repair of DNA. Part A. Hanawalt, P. C. (ed.). New York; Plenum Press (1975).

From DNA repair processes conference; Squaw Valley, California, USA (Feb 1974). See CONF-740231-PA.

The catalytic reactions of the recBC enzyme of Escherichia coli with various substrates are reviewed, and a model for the sequence of events in the degradation of duplex DNA is presented. The potential of the enzyme to take part in genetic recombination and repair is discussed. (auth)

**12524** INTERRELATION BETWEEN ELONGATION AND IAA-1-$^{14}C$ METABOLISM IN WHEAT COLEOPTILE SECTIONS. Lis, E. K.; Antoszewski, R. (Instytut Sadownictwa, Skierniewice (Poland)). Biol. Plant. (Prague); 16: No. 5, 366-372(Sep 1974).

From international conference of plant growth substances; Liblice, Czechoslovakia (1972).

An intensive elongation of wheat coleoptile sections was shown to be correlated with the indoleacetic acid-1-$^{14}C$ metabolism. In actively growing tissues the disappearance of indoleacetic acid-1-$^{14}C$ and the formation of conjugates and metabolites (indoleacetamide, indoleacetyl-β-D-glucose, indoleacetyl aspartic acid) is twice as high as in the sections where growth was stopped by a physical constraint (plaster) or in the tissue which did not elongate for an unknown reason. (auth)

**12525** ABSCOPAL RECONSTRUCTION OF BONE TISSUE. Clinical Proof by $^{85}Sr$. Kolar, J. (Karlova Universita, Prague (Czechoslovakia). Fakulta Vseobecneho Lekarstvi); Babicky, A. (Ceskoslovenska Akademie Ved, Prague. Isotopova Laborator Biologickych Ustavu); Janko, J. (Karlova Universita, Prague (Czechoslovakia). Biofyzikalni Ustav). Cas. Lek. Cesk.; 112: No. 19, 594-597(11 May 1973). (In Czech).

Non-specific reconstructions are discussed found in the bones of the extremities in man. The changes are manifested by an increased uptake of $^{85}Sr$. They are considered to be a response to central irritation mediated by neurotrophic pathways, thus confirming also in man the existence of abscopal reconstructions, described so far in animals. (INIS)

**12526** MORPHOLOGY AND AUTORADIOGRAPHY STUDIES OF GYNAECOLOGICAL TUMORS IN ORGAN CULTURE. Siracky, J.; Matoska, J.; Siracka, E. (Vyskumny Ustav Onkologicky, Bratislava (Czechoslovakia)). Neoplasma; 21: No. 3, 307-312 (1974).

Explants of 52 gynaecological cancers (32 uterine cervix epidermoid cancers and 20 endometrial cancers) were investigated in short term organ cultures by using the fibrin foam technique. In more than 60% of cases, a successful growth in both types of cancer was achieved. The incorporation of $^3H$-thymidine studied by histoautoradiography in 22 cases (13 uterine cervix and 9 endometrial cancers) showed decreased values of the labelling index (L. I.) on the first day and a marked increase on the 7th day of cultivation. The average L. I. values were significantly higher in endometrial cancer over the whole period of cultivation. (auth)

**12527** PORTABLE SYSTEM FOR THE MEASUREMENT OF PHOTOSYNTHESIS USING 14-CARBON DIOXIDE. Tieszen, L. L. (Aufustana College, Sioux Falls, South Dakota (USA)); Johnson, D. A.; Caldwell, M. M. (Utah State University, Department of Range Science and the Ecology Center, Logan (USA)). Photosynthetica; 8: No. 3, 151-160(Sep 1974).

The system is based on the uptake of $^{14}CO_2$. The exposure chamber for intact leaves or other plant structures can be used with or without a portable temperature control unit. Rapid in-vial combustion procedures, an efficient counting system, and accurate calibrations result in rapid analyses of in situ photosynthesis data. (auth)

**12528** ENZYMIC METHOD FOR THE DETERMINATION OF [1-$^{14}C$] LACTOSE. Davies, E.; Bourke, E.; Costello, J. Analyst; 100: No. 1195, 758-760(Oct 1975).

A simple, rapid, and specific method for the determination of [1-$^{14}C$] lactose in biological fluids is described. It is based on the enzymic removal of the 1-$^{14}C$ atom of lactose as [$^{14}C$] carbon dioxide, using commercially available enzymes. The assay involves only one critical addition and the entire reaction can be carried out in a scintillation vial. (auth)

**12529** FOOD AND ENVIRONMENTAL QUALITY PROTECTION. Winteringham, F. P. W. Int. At. Energy Agency Bull.; 17: No. 5, 14-25(Oct 1975).

The development and current application of stable and radioactive isotopes in food, agricultural, and environmental research are discussed. The use of radioisotopes as monitoring tools in agriculture and environmental studies is also discussed. (ERB)

**12530** NEW DIAGNOSTIC POSSIBILITIES OF A COMBINED RADIOCARDIOPULMOCIRCULOGRAPHIC METHOD IN PULMONOLOGY. Vaskov, L. S. (Medical Academy, Sofia). Radiobiol. Radiother.; 16: No. 4, 467-472(1975).

A combined radioisotopic method which enables determination of the central circulation time and blood volume as well as in the pulmonary artery and veins separately is described. It was carried out in 316 healthy individuals and patients with different chest diseases. The comparison with other clinical data and the long-term observations with the development of the diseases showed the diagnostic value of the method in the different clinical stages of cardiovascular complications. (auth)

**12531** IMMUNOCHEMISTRY OF THE INTERACTION OF THYROGLOBULIN (Tg) AND ITS AUTO- AND HETERO-ANTIBODIES. Salabe, G. B. Acta Endocrinol., Suppl.; No. 196, 1-25(1975).

From 6th annual meeting of the European Thyroid Association; Prague, Czech. (27 Jun 1974).

Autoantibodies are directed toward a limited number of antigenic determinants which are formed by the folding of the secondary and tertiary structure of the antigen. A class of autoantibodies of restricted heterogeneity accumulate in the thyroid and possibly are inportant in the initiation of cell damage. Their structural and functional homogeneity favor the hypothesis of monoclonal origin of autoimmune thyroiditis in which a single clone of lymphocytes proliferates and produces anti-thyroglobulin antibodies. Antigenic determinants hidden in the native molecule are present in the incomplete nascent chains of newly synthesized Tg. (DA)

**12532** TISSUE DISTRIBUTION OF METOPROLOL-($^{3}$H) IN THE MOUSE AND THE RAT. Bodin, N. O.; Borg, K. O.; Johansson, R.; Ramsey, C. H.; Skaanberg, I. (Astra Pharmaceuticals AB, Soedertaelje, Sweden). Acta Pharmacol. Toxicol., Suppl.; 36: No. 5, 116-124(1975).

The tissue distribution of specifically tritium-labelled metoprolol was studied in mice by whole-body autoradiography and in rats by determination of unchanged drug and the total pool of metabolites in pre-selected tissues. The distribution after intravenous administration was characterized by a rapid localization to various tissues e.g. liver, kidney, gall bladder, urinary bladder, salivary glands, Harder's gland, spleen, lungs and adrenals. In the pregnant mouse the drug and/or its metabolites crossed the blood-placenta barrier and moderate concentrations were found in the fetus. Metoprolol was metabolized to a large extent in the rat and after oral administration the total pool of metabolites exceeded the concentration of unchanged drug in the tissues studied. (DA)

**12533** TRICYCLIC ANTIDEPRESSANT AGENTS. I. Comparison of the Inhibition of the Uptake of $^{3}$H-Noradrenaline and $^{14}$C-5-Hydroxytryptamine in Slices and Crude Synaptosome Preparations of the Midbrain-Hypothalamus Region of the Rat Brain. Ross, S. B.; Renyi, A. L. (Astra Pharmaceuticals AB, Soedertaelje, Sweden). Acta Pharmacol. Toxicol.; 36: 382-394(1975).

The simultaneous uptake of $^{3}$H-1-noradrenaline (NA) and $^{14}$C-5-hydroxytryptamine (5-HT) in slices from the midbrain-hypothalamus region of the rat brain was compared with the corresponding uptake in crude synaptosome preparations of the same brain region. In both preparations the uptake of the two amines was selective at the concentration used ($1 \times 10^{-7}$ M or lower). The $K_M$ values for the amines (NA: $2 \times 10^{-7}$ M in synaptosomes and $5 \times 10^{-7}$ M in slices; 5-HT: $8 \times 10^{-8}$ M in synaptosomes and $6 \times 10^{-7}$M in slices) and the inhibitory concentrations ($IC_{50}$) of the antidepressant agents were lower in the synaptosome experiments than in the slices experiments. Moreover the order of the inhibitory activities differed between the two preparations. In the slices experiments the NA uptake was inhibited most markedly by desipramine followed by imipramine > chlorimipramine = nortriptyline ≥ amitriptyline ≥ chlordesipramine whereas in the synaptosome experiments the order was desipramine > nortriptyline ≥ chlordesipramine ≥ imipramine > amitriptyline ≥ chlorimipramine. For the 5-HT uptake in slices the order of activity was chlorimipramine > imipramine ≥ amitriptyline ≥ chlordesipramine = desipramine ≥ nortriptyline whereas in the synaptosome preparations the order was chlorimipramine > imipramine ≥ amitriptyline ≥ chlordesipramine > nortriptyline = desipramine. The role of protein binding and diffusion barriers in the causation of the difference in the results obtained with the two preparations is discussed. (DA)

**12534** TRICYCLIC ANTIDEPRESSANT AGENTS. II. Effect of Oral Administration on the Uptake of $^{3}$H-Noradrenaline and $^{14}$C-5-Hydroxytryptamine in Slices of the Midbrain-Hypothalamus Region of the Rat. Ross, S. B.; Renyi, A. L. (Astra Pharmaceuticals AB, Soedertaelje, Sweden). Acta Pharmacol. Toxicol.; 36: 395-408(1975).

The inhibition of the simultaneous uptake of $^{3}$H-1-noradrenline (NA) and $^{14}$C-5-hydroxytryptamine (5-HT) in slices of the midbrain-hypothalamus region of the rat brain after oral administration of desipramine, imipramine, nortriptyline, amitriptyline, chlordesipramine, and chlorimipramine was determined. All compounds were more active in inhibiting the NA uptake than the 5-HT uptake. This difference was very marked for desipramine, imipramine, nortriptyline and chlordesipramine. Chlorimipramine was almost as active on the 5-HT uptake ($ED_{50}$ = 35 mg/kg orally) as on the NA uptake ($ED_{50}$ = 20 mg/kg orally) and amitriptyline had low activity on both uptake mechanisms ($ED_{50}$ > 50 mg/kg orally). Desipramine and imipramine were the most active compounds on the NA uptake ($ED_{50}$ = 8 mg/kg orally for both compounds) and the duration of the action was very long. The $ED_{50}$ values for nortriptyline and chlordesipramine in inhibiting the NA uptake were about 20 mg/kg orally for both compounds. The inhibition of the 5-HT uptake was less than 50% at 50 mg/kg orally for all compounds except for imipramine ($ED_{50}$ = 50 mg/kg orally) and for chlorimipramine. The role of the biotransformation for the inhibitory activities of imipramine, chlorimipramine and amitriptyline was investigated in animals pre-treated with SKF 525 A. The inhibitory potency of imipramine was increased by the same factor for both uptake mechanisms probably due to the large increase in the concentration of imipramine in the rat brain which was demonstrated after the administration of $^{14}$C-imipramine. The inhibitory activity of chlorimipramine was somewhat more increased for the 5-HT uptake than for the NA uptake. The low activity of amitriptyline seems to be mainly due to poor resorption, since pretreatment of the animals with SKF 525 A only slightly increased the potency whereas intraperitoneal injection of amitriptyline had a rather marked effect on the NA uptake ($ED_{50}$ = 11 mg/kg intraperitoneally). (DA)

**12535** PHARMACOKINETICS OF CYCLOPHOSPHAMIDE IN RENAL FAILURE. Mouridsen, H. T.; Jacobsen, E. Acta Pharmacol. Toxicol.; 36: 409-414(1975).

The metabolism of cyclophosphamide was determined in five patients with severe renal insufficiency. After the intravenous injection of $^{14}$C-cyclophosphamide the activities due to unchanged cyclophosphamide and metabolites were determined in samples from urine and serum for 2 to 3 days. Only 22% of the injected radioactivity could be recovered in the urine during the first 3 days as against the normal of some 65%. The rate of biotransformation seemed normal and in agreement with these findings a very long term retention of metabolites could be demonstrated. The clinical implications of these results are discussed. (DA)

**12536** NEUROGENIC CONTROL OF MUSCLE RIBOSOMAL PROTEIN SYNTHESIS. Ionasescu, V.; Lewis, R.; Schottelius, B. (Univ. of Iowa, Iowa City). Acta Neurol. Scand.; 51: 253-267 (1975).

In vitro protein synthesis of ribosomes extracted from leg muscles of 20 Sprague-Dawley rats denervated 3 and 14 days (high sciatic transections) and 10 control rats was studied. The concentration/mg protein of total ribosomes extracted from the 14-day denervated muscle showed a significant increase. Distribution of muscle polyribosomes on sucrose density gradients was normal in all cases. Noncollagen protein synthesis of the heavy polyribosomes from both early and late denervated muscles showed a significant decrease. SDS polyacrylamide gels suggested that this decrease affected the synthesis of heavy chains of myosin, while the light chains of myosin, actin, and tropomyosin had normal structure and amounts. Collagen synthesis of heavy polyribosomes showed slight to moderate increase in only 50% of the cases. Supplementation of ribosomes extracted from denervated muscles with normal muscle soluble enzymes increased their noncollagen synthesis by 66%. This suggests that the neurogenic control of ribosomal protein synthesis is accomplished by hormonal trophic substances contained in the muscle soluble enzymes. (DA)

**12537** VITAMIN $B_{12}$ ABSORPTION EVALUATED BY A DUAL ISOTOPE TEST (DICOPAC). Results of Radioactivity Measurements in Plasma and in Urine. Knudsen, L.; Hippe, E. (Gentofte Hospital, Copenhagen). Scand. J. Haematol.; 13: 287-293(1974).

The results of an urinary excretion test for vitamin $B_{12}$ absorption (Schilling test) in a patient with renal failure may be indistinguishable from those obtained for a patient with general intestinal malabsorption. Therefore the value of measuring plasma levels of radioactivity during a double isotope test (Dicopac) was examined in order to determine the usefulness of this test in distinguishing between these conditions. After the oral administration of 0.5 μg $^{58}CoB_{12}$ bound to intrinsic factor and an i.m. flushing dose of 1 mg cyanocobalamin, the radioactivity in 8 h plasma and in 24 h urine was determined in various patients and control subjects. In 13 patients with pernicious anaemia the absorption of vitamin $B_{12}$ was significantly reduced as estimated

from the level of $^{58}$Co radioactivity found in the plasma and in the urine sample (median values being 0.2% per litre of plasma and 2.5% per 24 h urine). The corresponding values observed for the $B_{12}$-intrinsic factor absorption ($^{57}$Co radioactivity) were in most of the cases normal, i.e. above 0.45% and 6%, respectively. A few patients with untreated pernicious anaemia initially had an intestinal malabsorption present, resulting in low $^{57}$Co values, which were normalized after treatment with vitamin $B_{12}$. The dual-isotope technique described is available as a screening procedure to elucidate the reason for a low serum vitamin $B_{12}$ level. The test will classify the patients into one of three groups: normal, pernicious anemia, and "malabsorption." (auth)

**12538** EFFECT OF VITAMIN E ON HAEMOLYSIS IN PAROXYSMAL NOCTURNAL HAEOGLOBINURIA: IN VITRO AND IN VIVO STUDIES. Gomperts, E. D.; Zail, S. S.; Christensen, D.; Metz, J. (Univ. of Witwatersrand, Johannesburg). Scand. J. Haematol.; 14: 81-85(1975).

The administration of vitamin E, a natural antioxidant, to a patient with paroxysmal nocturnal haemoglobinuria (PNH) failed to diminish the urinary excretion of $^{59}$Fe as monitored by $^{59}$Fe whole body counting and urinary loss of isotope. However, in vitro vitamin E corrected the increased sensitivity of PNH red cells to haemolysis by hydrogen peroxide. These results support the concept that the susceptibility of PNH red cells to lipid peroxidation is an in vitro phenomenon bearing little relation to the mechanism of in vivo haemolysis. (DA)

**12539** THYMUS CELL MIGRATION. Joel, D. D.; Chanana, A. D.; Cronkite, E. P. (Brookhaven National Lab., Upton, NY). Ser. Haematol. (Copenhagen); 7: No. 4, 464-481(1974).

In both neonatal and young adult animals there was stated a substantial emigration of lymphocytes from the thymus. Cells of various nuclear size categories have been shown to emerge via thymic veins and thymic lymphatics. Studies with $^{3}$HTdR and $^{125}$IUdR indicate significant intrathymic cell death. Thymic emigrants have been shown to be the main source of cells comprising the recirculating pool of lymphocytes. (EG)

**12540** FURTHER MINIATURIZATION AND AUTOMATION OF IN VITRO LYMPHOCYTE CULTURES. Miggiano, V. C.; Meo, T.; Birgen, I.; Nabholz, M. (Basel Inst. for Immunology). Tissue Antigens; 5: 173-185(1975).

A microtechnique (10 $\mu$l culture volume) for in vitro lymphocyte cultures is described which, compared with current miniaturized techniques, permits a four- to 20-fold reduction of both medium volume and cell numbers. Futhermore, two alternative procedures for harvesting and washing radioisotope labelled cells are described. The first, making use of a conventional harvesting device, collects cells on glass fibre filters in a two- to three-fold shorter time than that needed for the current semi-automatic collectors. The second takes advantage of the possibility of washing and fixing the cells in their culture wells and allows processing of more cultures with fewer manual operations. Various technical aspects of the micro-culture system are described and discussed with special reference to automation problems. (DA)

**12541** REPRODUCIBILITY OF BONE SCINTIGRAPHY WITH $^{99m}$Tc POLYPHOSPHATE. Pors Nielsen, S.; Mouridsen, H. T.; Toennesen, K. H. (Glostrup Sygehus, Copenhagen). Ugeskr. Laeger; 137: No. 4, 196-198(1975). (In Danish).

The principle of bone scintigraphy with $^{99m}$Technetium polyphosphate ($^{99m}$TcPF) is reviewed. The advantages of this method are accounted for in contrast to methods of bone scintigraphy previously employed. The irradiation dose is limited and no side-effects were observed with the doses used. A $\gamma$ camera method evolved by the authors for quantitative bone scintigraphy with $^{99m}$TcPF is presented. The variation coefficient for repeated investigations with this method was 3.8% as assessed by 11 double investigations of bone metastases in patients with cancer of the breast. (DA)

**12542** APPEARANCE OF ACID PHOSPHATASE STAINING IN SENSITIZED LYMPHOID CELLS DURING THEIR LYSIS OF ALLOGENEIC FIBROBLASTS. Poulsen, P. B.; Guettler, F.; Nobert Joergensen, P. (Copenhagen Univ.). Acta Pathol. Microbiol. Scand., Sect. C; 83: 83-94(1975).

Immune spleen cells or activated thymus cells were incubated with appropriate $^{51}$Cr-labelled target fibroblasts. The interaction of lymphoid cells and target cells was stopped by fixation in formalin vapor. Target cell lysis was evaluated by the release of $^{51}$Cr and the cultures were stained for acid phosphatase activity by the simultaneous capture technique, using naphthol AS-BI phosphoric acid and fast red-violet LB salt. The sensitized lymphoid cells aggregated around cultured donor-type fibroblasts within a 4-hour incubation period and staining for acid phosphatase activity appeared in the lymphocytes. The reaction was immunologically specific, as staining was observed only in the immune spleen cells or activated thymocytes incubated with target cells possessing the allo-antigens to which the cell donor was sensitized. Specific adsorption on fibroblast monolayers syngeneic, but not allogeneic, to the H-2 allo-antigens against which the thymus cells were activated, reduced both the specific release of $^{51}$Cr from labelled target cells and the number of thymus cells staining for acid phosphatase activity. Acid phosphatase staining and cytolytic activity were reduced in lymphocyte-target cell cultures incubated in the presence of prednisolone or heparin. A significant correlation was found between target cell lysis and number of acid phosphatase-positive spleen cells in relation to time of interaction and lymphocyte: target cell ratio. (DA)

**12543** FUNCTIONAL ALTERATIONS INDUCED BY CHLORPROMAZINE IN MONONUCLEAR BLOOD CELLS CULTURED IN VITRO. Oedegaard, A. (Trondheim Central Hospital, Norway). Acta Pathol. Microbiol. Scand., Sect. C; 83: 59-73(1975).

The effect of Chlorpromazine (CPZ), a membrane active drug, on the morphology and function of blood monocytes and lymphocytes cultured in vitro, was studied. The experiments indicate that CPZ exhibits a strong and dose dependent effect on cell membrane functions like cell adhesiveness and phagocytosis of radiolabelled Candida particles. A biphasic effect was found on the attachment of cells at culture start and on the attachment/engulfment of particles in the cultured cells. Low drug concentrations were found to increase adhesiveness while higher concentrations caused cell lysis. Chlorpromazine in lytic concentrations decreased the intracellular digestion of Candida particles. Small drug concentrations did not appear to influence the digestion of particles as observed morphologically, but a decreased release of metabolized $^{125}$Iodine to the medium was found, suggesting a stabilization of the cell membrane, with reduced transfer of the digested material to the medium. (DA)

**12544** FIBRIN DEGRADATION PRODUCTS AND THE $^{125}$I-LABELED FIBRINOGEN TEST IN PATIENTS WITH MYOCARDIAL INFARCTION. Morris, G. K.; Hayes, M. J.; Hampton, J. R. (Nottingham Medical School, Eng.). Eur. J. Cardiol.; 2: No. 1, 35-38(Aug 1974).

Measurements of serum fibrinogen degradation products (FDP) were made in eighty patients with chest pain admitted to a coronary care unit and the development of deep venous thrombosis was monitored by the $^{125}$I-labeled fibrinogen test. 24 patients at some stage showed a rise in serum FDP, and fifteen patients developed evidence of a deep venous thrombosis, but there was no correlation between these abnormalities. The maximum recorded serum glutamic-oxalacetic transaminase (SGOT) suggested that the patients with raised FDP levels had significantly more severe myocardial infarctions than those with normal FDP levels, but there was a considerable overlap between the two groups. (auth)

**12545** DETERMINATION OF THE STRUCTURE OF THE IMMUNODOMINANT GROUPS OF THE CANINE SECRETORY ALLOANTIGENS (CSA) BY RADIOIMMUNOASSAY. Oriol, R.; Strecker, G.; Rousset, M.; Chevalier, G.; Dalix, A. M.; Dussaulx, E.; Sweibaum, A. (Hopital Broussais, Paris). Transplant. Proc.; 7: No. 4, 523-528(Dec 1975).

In the original description of the CSA system, seven different phenotypes were considered. The present study suggests that these may actually be reduced to four phenotypes: A, X, Y, and AY. The model illustrates the immunodominant groups of these four types of molecules. The chemical linkages proposed are based on the inhibition tests observed with oligosaccharides. In conclusion, the CSA system is, among all of the known polymorphic systems of the dog, the one most closely related to the human ABH-Le system and may correspond to its phylogenic equivalent in dogs. (auth)

**12546** RADIOIMMUNE DETERMINATION OF HYPOXANTHINE PHOSPHORIBOSYLTRANSFERASE CROSSREACTING MATERIAL IN ERYTHROCYTES OF LESCH-NYHAN PATIENTS. Ghangas, G. S.; Milman, G. (Univ. of California, Berkeley). Proc. Natl. Acad. Sci. U.S.A.; 72: No. 10, 4147-4150(Oct 1975).

We have developed a sensitive radioimmunoassay capable of detecting and quantitating 20 ng of hypoxanthine phosphoribosyltransferase (EC 2.4.2.8; IMP: pyrophosphate phosphoribosyltransferase) protein. For this assay, hypoxanthine phosphoribosyltransferase from human erythrocytes was iodinated with $^{125}$I under mild conditions using hydrogen peroxide and lactoperoxidase attached to Sepharose-4B. Antisera prepared against homogeneous human hypoxanthine phosphoribosyltransferase precipitates the iodinated enzyme as effectively as the unlabeled enzyme. The radioimmunoassay has been used to look for hypoxanthine phosphoribosyltransferase crossreacting material in hemolysates from sixteen different patients with a marked genetic deficiency of this enzyme characteristic of the Lesch-Nyhan syndrome. Fifteen hemolysates contained no detectable crossreacting mate-

rial. One hemolysate contained a normal amount of crossreacting material. Hypoxanthine phosphoribosyltransferase from this patient has been shown to be a K/sub m/ mutant enzyme. (auth)

**12547** DEMONSTRATION OF TUMOR-ASSOCIATED ANTIGENS IN DOGS. Warren, R. P.; Tsoi, M. S.; Henderson, B. H.; Weiden, P. L.; Storb, R. (Univ. of Washington, Seattle). Transplant. Proc.; 7: No. 4, 481-484 (Dec 1975).

Procedures for the $^{51}Cr$ release assay using labeled L cells or lymphocytes and the indirect leukocyte migration test are described. These assays appear capable of detecting cellular immunity against tumor associated antigens in dogs. In 8 of 14 instances, lymphocyte-mediated cytotoxicity to autochthonous L cells was found as measured by $^{51}Cr$ release, and lymphocytes from 12 of 24 dogs produced the migration inhibition factor (MIF) when cultured with autochthonous tumor cells. Chromium-51 release occurred with 4 h of exposure of effector cells to target cells, suggesting that the immunity detected in the tumor dogs against their tumors is also present in vivo. With the leukocyte migration test, however, consistent MIF production was achieved only after 3 to 6 days in culture, suggesting that in vitro sensitization may result in increased MIF production. (HLW)

# MATERIALS

## Ceramics and Cermets

*Refer also to abstracts 11511, 11522, 11577, 11789, 12622, 12665, 12909, 13967, 13984, 13989, and 14030.*

**12548** (JAERI-M-6014) SINTERING OF URANIUM MONONITRIDE. Takahashi, T.; Kido, T.; Kikuchi, T. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 29p. INIS.

Uranium mononitride was produced by decomposing the sesquinitride in vacuum at various temperatures. Sintering of the mononitride at 1800°C for 4 hours in argon was studied for the powders prepared under different conditions. The sintered density considerably depended on the milling time of the powders; the highest density attained was 95% of the theoretical for the nitride milled for 66 to 72 hours. The decomposition temperature of $U_2N_3$ into UN did not so much influence the sintered density as the milling time did. In the sintered material open pores dominate below density 90% of the theoretical, and closed pores do above this value. Some of characterizations of the sintered specimens were also carried out. (auth)

**12549** (INIS-mf-1761, pp 66-100) METAL–NON METAL TRANSITION IN $VO_2$: A $^{57}Fe$ MOESSBAUER STUDY. Blaauw, C. 4 Oct 1974.

In investigation of some systems exhibiting electrical conduction anomalies. (Rijksuniversiteit Groningen (Netherlands)).

The system $V_{1-x}Fe_xO_2$ was investigated in the region $0 \times 0.04$ with the Moessbauer effect technique. Both stoichiometric and non-stoichiometric material was studied. The results indicate that trivalent iron is present in all cases. The different crystallographic phases in the system were distinguished through their Moessbauer spectra. The spectra obtained in Ml phase material, which has a small impurity concentration, suggest the presence of impurity induced structural distortions, depending on the history of the samples. In oxygen deficient samples shear planes are formed in which $Fe^{3+}$ ions preferentially occupy the cation positions. (INIS)

**12550** TRENDS IN USE OF CARBIDE TOOLS. Mansfield, F. M. Am. Mach.; 118: No. 15, 55(22 Jul 1974).

Carbide tool use, notably the use of coated WC, is growing at a faster rate than the economy. A user survey showed that WC accounts for 70 percent and its usage is increasing, for the entire range of applications, from cutting small screws to nuclear equipment. Titanium carbide-coated WC accounts for 14 percent and is being used even more for greater tool life or higher speeds. Solid TiC with 5 percent usage is employed for higher cutting speeds. Ceramics usage has stabilized with some decline and amounts to 5 percent. (Metals Abstr.)

**12551** EROSION RESISTANCE OF CARBIDE ALLOYS OF ZIRCONIUM AND NIOBIUM IN THE HOMOGENEITY REGION. Samsonov, G. V.; Verkhotorov, A. D.; Naumenko, V. Ya.; Kikalova, L. N. Elektron. Obrab. Mater.; No. 4, 10-11(1974). (In Russian).

The erosion properties of carbide alloys of zirconium and niobium in their homogeneity regions were investigated. Specimens were made from powders prepared by the synthesis method from metals and acetylene black, calculated for a given composition (C/Me = 0.8 to 1.0), in a vacuum resistance furnace at 1800°C for 3 h. The powder mixes of Zr and Nb were rated for obtaining carbide alloys of $Zr_xNb_{1-x}C_y$ compositions with a 10 mole% step of the corresponding carbide. The dependence of the electroerosion resistance of the alloys on their composition shows that with increasing NbC content in applying carbide alloys $Zr_xNb_{1-x}C_{0.91}$ and $Zr_xNb_{1-x}C_{0.82}$ the intensity of the erosion process decreases to the minimum for equimolar compositions and then increases. The character of the change of microhardness of $Zr_xNb_{1-x}C_y$ carbide alloys is shown to be similar to that of the erosion intensity. The established extreme behavior of electrospark erosion and microhardness of solid Zr and Nb solutions in the region of their homogeneity for carbon-defective carbide alloys in the case of equimolar composition indicates the predominant role of the $Me^{IV}$-$Me^{V}$ interactions in the total bonding energy in the formation of solid solutions of carbides. (JPRS)

**12552** HIGH STRENGTH MATERIAL EL'BOR. Lysanov, U. S. Stanki Instrum.; 28-29(7 Jul 1975). (In Russian).

A study of the properties of el'bor, a synthetic material based on cubic boron nitrides, shows that it may be used as a highly effective abrasive since its microhardness is greater than corundum and the metal carbides. The effectiveness of the abrasive is related to the % of boron nitride, usually > 90%; to the composition of the remaining 10%; and to the method of preparing the crystals which in turn alters the crystal lattice slightly. Boron nitride is very stable, being insoluble in both dilute and concentrated acids and bases. It does not decompose in melts of the alkali metals or their salts, is inert to iron and is not oxidized by water vapor at temperatures below 80°C. Incipient oxidation was observed, however, when samples were heated to 1200°C for an hour; however, the degree of oxidation was related to not only time and temperature but also to grain size. Nine applications of boron nitride are discussed, the majority involving its use as a polishing abrasive compound. (JPRS)

**12553** RELATIONSHIP BETWEEN THE FINE STRUCTURE AND SERVICE QUALITIES OF A HARD ALLOY OF THE TUNGSTEN CARBIDE–COBALT TYPE. Spasov, N.; Isakov, I; Mikov, A.; Kochanova, O. God. Nauchnoizsled. Inst. Tsvetna Metal., Plovdi; 9: 81-87(1971). (In Bulgarian).

The relationship between the microstructure and service qualities (hardness, strength, wear resistance) of hard alloys of the WC–Co type is discussed in the light of extensive practical experience and special tests. The service qualities depend largely on the phase composition and structure, and the sub-structure of the alloy. In particular, with increasing dislocation density and stresses of the second kind, and with diminishing mosaic block size, the service qualities of WC–Co alloys improve. This improvement is consistent with the fact (established by x-ray diffraction) that the lattice constant of the Co constituent increases substantially with increasing content of dissolved WC. (Metals Abstr.)

**12554** THERMODYNAMICS OF INTERSTITIAL HYDROGEN SOLID SOLUTIONS AND METAL HYDRIDES. Stafford, S. W. Houston, TX; Rice Univ. (1975). 112p. University Microfilms Order No. 75-22,071.

Thesis (Ph. D.).

Statistical mechanical models have been calculated in which both repulsive and attractive hydrogen solute interactions are considered. These are used in analyzing the variation of the partial thermodynamic functions of hydrogen solute atoms with solute concentration in Group V metals Nb, Ta and V. The comparison between the calculated thermodynamic functions and the experimental data is in favor of the repulsive interaction model in which relatively short range interactions restrict the solute atoms to cells of interstitial sites. It has been shown that, at low temperatures, the population of cells by more than one solute atom occurs only to a small extent. Using these models, the variation of the specific heat with temperature for non-stoichiometric metal hydrides is compared with the measured specific heat plots for palladium and Group V metal hydrides. The solubility of hydrogen in nickel and cobalt at atmospheric pressure has been measured over large temperature ranges. The measured solubility data have been interpreted using a solid solution model involving sites of differing energy at which solute atoms can be located. The hydrogen solubility in iron (both polycrystalline and single crystal form) has been measured at one atmospheric pressure. Departure from Arrhenius behavior has been observed at low temperatures in the polycrystalline sample of high purity (99.999 percent). Solubility measurements for the single crystal (99.9+ percent) followed data of previous investigators using polycrystalline samples of similar purity, and further revealed an increase in solubility as compared to high purity data. The solubility of hydrogen in binary iron-nickel alloys has been measured over large temperature ranges at atmospheric pressure. From the temperature dependence of the solubility, the partial thermodynamic properties of the interstitially dissolved hydrogen have been derived. The variation of the partial enthalpy of solution with binary composition has been compared with the electronic structure of the solvent. (Diss. Abstr. Int., B)

**12555** USE OF COATINGS OF TITANIUM CARBIDE AND ZIRCONIUM CARBIDE AS DIFFUSION BARRIERS IN COMPOSITE MATERIALS. Kartsinos, D. M.; Kosolapova, T. Ya.; Samoylenko, V. G.; Fedorenko, V. K.; Markitanova, V. N. Zashch. Pokrytiya Met.; No. 8, 150-155(1974). (In Russian).

Coatings of the carbides of Ti and Zr were applied to W and Mo fibers by cathode ray and vapor-gas atomization methods. Metallographic and x-ray microspectral analyses were used to study the compatibility of these compounds with the materials of the fibers and matrices. The influence of the coatings produced on the strength and deformation properties of the reinforcement was also studied. The strength of the bond between fiber and matrix changes only slightly when diffusion barriers are introduced in the temperature interval studied. All of the studies performed

indicate that these carbides are promising as diffusion barriers. (Ref. Zh.)

**12556** OBSERVATION OF SHAPE EFFECTS IN TERBIUM ORTHOFERRITE. Bouree, J. E.; Hammann, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). J. Phys. (Paris); 36: No. 5, 391-397(May 1975). (In French).

The low temperature magnetic properties of terbium orthoferrite have been studied by means of magnetization measurements performed on various samples between 1 and 10°K. The curves obtained for the x and y crystallographic direction enable characteristic parameters of the $Tb^{3+}$ ions to be determined. Although these values are the same, measurements along the z axis clearly show up two kinds of samples with different behavior as a function of temperature. This discrepancy is accounted for by shape effects, which arise from the possibility of domain wall motion. These shape effects are due to dipolar interactions and are consistent with the predictions of the theoretical phase diagram published previously. (FR)

**12557** ELECTRICAL CONDUCTIVITY OF THE $ThO_2-YO_{1.5}$ SYSTEM. II. An Attempt of Interpretation of the Ionic Conductivity. Hammou, A. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, 38- Grenoble (France)). J. Chim. Phys.; 72: No. 4, 439-447(Apr 1975). (In French).

An attempt was made to explain the variation of the ionic conductivity with the concentration of charge carriers in the $(ThO_2)_{1-x}-(YO_{1.5})_x$ system. Two models were tested: the Lidiard's model based on the presence of complexes and Debye-Huckel interactions and the Barker's model with constraint of jump. None of these models give complete satisfaction. The activation energy is the predominant factor for the evolution of ionic conductivity versus dopant concentrations in this type of solid solutions. (FR)

**12558** ELECTRICAL CONDUCTIVITY OF THE $ThO_2-Yo_{15}$ SYSTEM. I. Experimental Study and Electronic Conductivity. Hammou, A. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, 38- Grenoble (France)). J. Chim. Phys.; 72: No. 4, 431-438(Apr 1975). (In French).

The electrical conductivity of the $(ThO_2)_{1-x}-(YO_{1.5})_x$ solid solution, which crystallizes in the fluorite system was studied. The specimens are prepared by the "citrates" method and exhibit a high density and a good homogeneity. The electrical conductivity has been studied as a function of: temperature $1045 \leq T \leq 400$°C: oxygen partial pressure $1 \leq P_{O_2} \leq 10^{-20}$ atm; composition $0.05 < x < 21.45$ moles % $YO_{1.5}$. The study shows that no variation of the electrical conductivity with time was observed. The ionic conductivity varies linearly with dopant concentrations for $0.05 < x < 1$ mole % $YO_{1.5}$. The activation energy calculated in this region is equal to 1.1 eV. The ionic conductivity curves show a maximum at approximately 15 moles % $YO_{1.5}$ and the activation energy curve exhibits a minimum at the same composition. The results of the p type electronic conductivity at high oxygen partial pressure ($P_{O_2} > 10^{-6}$ atm) are in good agreement with theory. (FR)

**12559** REPLY TO COMMENT "THE AFFINITY OF OXYGEN FOR TWO ELECTRONS". Cantor, S. (Oak Ridge National Lab., TN). J. Chem. Phys.; 62: No. 11, 4584-4585(1 Jun 1975).

**12560** CLUSTER CALCULATIONS OF THE ELECTRONIC D-STATES IN $VO_2$. Sommers, C. (Paris-11 Univ., 91- Orsay (France). Lab. de Physique des Solides); de Groot, R. (Paris-11 Univ., 91- Orsay (France). Centre de Calcul); Kaplan, D.; Zylbersztejn, A. (Thomson-CSF, Domaine de Corbeville, 91-Orsay (France)). J. Phys. (Paris), Lett.; 36: No. 5, L.157-L.160(May 1975).

An ab-initio cluster calculation of the electronic d-states in $VO_2$ has been made by using the self-consistent statistical exchange multiple scattering method. $VO_6^{9-}$ octahedron was used to represent the tetragonal phase, and a $V_2O_{10}^{8-}$ cluster with paired vanadium atoms was used for the monoclinic phase. The results are in conflict with an explanation of the semiconducting gap in terms of simple distortion-induced band splitting. (FR)

**12561** PROCESS AND DEVICE FOR THE FABRICATION OF COMPACT BODIES FROM A PARTICULATE MATERIAL. Barbier, Y.; Lefevre, R. L. R.; Sturge, D. W. J.; Thomas, J. P. (to Commission of the European Communities). French Patent 2,223,152/A/. 22 Mar 1974. 13p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France); priority claim: 28 Mar 1973; 10 Dec 1973; 31 Jan 1974, UK.

A procedure and device for the fabrication of elongated compact bodies from particulate material is described. The material is compressed by applying opposed forces to it. These forces act in several longitudinal plans perpendicular to the central longitudinal axis which, after compression, is also the longitudinal axis of the elongated body. This process is applicable to the fabrication of nuclear fuel elements. (tr-FR)

**12562** METHOD FOR MANUFACTURING TARGETS FOR THE PRODUCTION OF PLUTONIUM, AND TARGETS THUS OBTAINED. Lorenzelli, R.; Paradis, G.; Pelou, C. (to Commissariat a l'Energie Atomique). French Patent 2,219,495/A/. 27 Feb 1973. 7p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to a method for the manufacture of sintered ceramics acting as targets, the irradiation of which leads to the production of $^{238}Pu$, characterized in that a nuclear oxide powder and a refractory oxide powder are blended together, their mixture being subsequently press-shaped and sintered at a high temperature. It is specified that said refractory oxide belongs to the group comprising MgO, $Al_2O_3$, CaO, $SiO_2$, BeO, and $ZrO_2$, whereas said nuclear oxide is $NpO_2$ or $AmO_2$. This method provides targets having various advantages. (FR)

**12563** METHOD FOR THE MANUFACTURE OF CERMETS FOR ISOTOPIC SOURCES, AND PRODUCTS THUS OBTAINED. Georgeoni, P.; Lorenzelli, R.; Marin, J. F. (to Commissariat a l'Energie Atomique). French Patent 2,219,131/A/. 26 Feb 1973. 11p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A method is described for the manufacture of cermets formed of $PuO_2$ and a refractory metal, said method comprising the steps of preparing calibrated balls of $^{238}PuO_2$ of from 50 to 100 microns, coating the balls with a binder then with a refractory metal, and sintering the thus coated balls in an inert or reducing atmosphere or in vacuo, at a temperature of from 1500 to 1750°C. This method comprises an $^{18}O$ depletion step carried out through isotopic exchange with $^{16}O$ in the gaseous form. The thus obtained cermets can be validly applied as energy sources, in particular for cardiac pacemakers. (FR)

**12564** COMPOSITION AND STRUCTURE OF NIOBIUM NITRIDE AND CARBONITRIDE FILMS OBTAINED BY REACTIVE SPUTTERING. Aubert, A.; Spitz, J. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de Metallurgie). Vide; 30: No. 175, 1-17(Jan 1975). (In French).

The elaboration of niobium nitride and carbonitride thin films by reactive sputtering of a niobium or niobium-carbon target under partial pressure of nitrogen or nitrogen + methane has been studied. The influence of the experimental conditions on the structure and electrical properties of the deposited materials are investigated in each case. The methods used for determining the composition and structure are described. The correlations observed between the nature of deposited materials and their superconducting properties are related. (FR)

**12565** STUDY OF THERMODYNAMICAL PROPERTIES OF BERYLLIUM OXIDE IN PHASE TRANSITION AREA. Shpiel'rain, E. E.; Kagan, D. N.; Barkhatov, L. S. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). Rev. Int. Hautes Temp. Refract.; 12: No. 1, 19-22(Jan 1975).

From 4th European conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

Enthalpy, heat capacity, thermal effects of structure conversion and melting of beryllium oxide were determined experimentally by a mixing technique in a boiling calorimeter. The heat of the hexagonal phase transition into cubic one is 0.7 kcal/mol (2,373K); the heat of melting is 20.9 kcal/mol (2,828K). The enthalpy error is 0.9 to 1.4%, that for the heat of structure conversion is 35%, that for heat of melting is 4.5%. (FR)

**12566** PHASE RELATIONSHIPS IN THE SYSTEM $ZrO_2-ThO_2$. Sakurai, T.; Arashi, H. (Tohoku Univ., Sendai (Japan). Research Inst. for Scientific Measurements). Rev. Int. Hautes Temp. Refract.; 12: No. 1, 74-77(Jan 1975).

From 4th European conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

The phase relationships in the system $ZrO_2-ThO_2$ were investigated using a 70 kW solar furnace. The specimens were fused and heat-treated at the focus of the solar furnace and rapidly cooled by dropping into water. The temperature of the specimen was measured by using an infrared pyrometric method. The structure of the melted portion was determined by means of X-ray diffraction analysis. The phase diagram at temperatures above 2,000°C was given in the concentration range from 7 to 100 mole % $ThO_2$. (FR)

**12567** STUDY OF AMORPHOUS METALLIC ALLOYS USING NEUTRON DIFFRACTION. Dixmier, J.; Sadoc, J. F. (Paris-11

Univ., 91- Orsay (France). Lab. de Physique des Solides); Bletry, J. (Institut Max von Laue - Paul Langevin, 38- Grenoble (France)). J. Phys. (Paris), Colloq.; No. 2, 65-68(1975). (In French).

From colloquium on dense random packing structure; Orsay, France (19 Jun 1974).

Preliminary results of neutron diffraction experiments on Ni–P and Co–P amorphous alloys are discussed. Scattering data for Ni–P were recorded up to $K_{max} = 30$. First details on the P atom distribution are given by using the reversion of the scattering amplitude ratios for Co and P atoms in x-rays and neutrons diffraction patterns. (FR)

**12568** TERNARY COMPLEX BORIDES WITH $ThMoB_4$-TYPE STRUCTURE. Rogl, P.; Nowotny, H. (Vienna Univ. (Austria). Inst. fuer Physikalische Chemie). Monatsh. Chem.; 105: No. 5, 1082-1098(Sep 1974). (In German).

Ternary complex borides of formula $MM'B_4$ were prepared within the systems Th–(V, Mo, W, Re)–B. The crystal structure of these compounds was determined by means of single crystal photographs of the compounds $ThMoB_4$, $ThWB_4$, $ThVB_4$, $ThMoB_4$, $ThWB_4$, and $ThReB_4$ were found to be isotypic. The relationship to the crystal chemistry of boron layer structures such as $AlB_2$, $YCrB_4$, and $Y_2ReB_6$ are discussed. (auth)

**12569** SELF-DIFFUSION COEFFICIENT OF HYDROGEN IN $NbH_{0.6}$. Zogal, O. J.; Cotts, R. M. (Cornell Univ., Ithaca, NY). Phys. Rev., B; 11: No. 7, 2443-2446(1 Apr 1975).

Direct measurements of the self-diffusion coefficient D of hydrogen in a hydrided single crystal of niobium were made between 90 and 243°C using the NMR pulsed-field-gradient technique. For $Nb_{0.6}$ in the alpha' phase, D equals $D_0$ exp (-E/sub alpha//kT), where $D_0$ equals 6.6 x $10^{-4}$ $cm^2$/sec and E/sub alpha/ equals 0.165 +- 0.008 eV/atom. By combining measurements of D and the spin-lattice relaxation rate for hydrogen, it is found that the rms jump distance $[l^2]$/sup ½/ has a value within the range 0.5b less than or equal to $[l^2]$/sup ½/ less than or equal to 0.8b, where b is the bcc lattice constant. Measurements of D are compared with published results for other hydrogen concentrations as obtained from quasielastic neutron scattering and Gorsky-effect experiments. (auth)

**12570** ESR AND OPTICAL STUDY OF THE INTERSTITIAL H CENTERS IN HEAVILY NEUTRON IRRADIATED LiF. Raoux, D. (Paris Univ., Orsay, France). J. Phys. Chem. Solids; 36: No. 11, 1165-1174(Nov 1975).

The paramagnetic spectra of the hole-centres created in LiF by a heavy neutron irradiation at 78°K have been studied by E.S.R. and optical techniques. Samples which have been irradiated at a dose at least equal to $10^{19}$ neutrons/$cm^2$ exhibit, after they have been warmed at 200°K, several spectra related to ⟨111⟩-oriented asymmetric centres. These centres are stable up to 500°K. One of them, designated the $H_{N1}$ centre, has been studied in detail. The analysis of the paramagnetic spectrum shows that this defect is an interstitial fluorine atom which forms an asymmetric $(F^{-\frac{1}{2}} - F^{-\frac{1}{2}})$ molecule ion with lattice fluorine ions. Optical experiments have shown that the excited Σ level is at 4.1 eV from the ground Σ level. Two excited π levels have been found at 2.5 and 2.1 eV. This asymmetric H centre is formed from a primary symmetric H centre, designated the $H_{N2}$ centre. The $H_{N2}$ centre is ⟨110⟩-oriented. The transformation of the symmetric $H_{N2}$ centre into the asymmetric $H_{N1}$ one is associated with important changes in the values of the isotropic hyperfine interaction and of the $g^{\perp}$ shift. (auth)

# Metals and Alloys

*Refer also to abstract 13687.*

## Corrosion and Erosion

*Refer also to abstracts 13926, 13945, 13961, 13966, and 14021.*

**12571** (CONF-751101-39) SELF-WELDING EVALUATION OF REACTOR MATERIALS IN FLOWING SODIUM. Chang, J. Y.; Flagella, P. N.; Schrock, S. L. (Westinghouse Electric Corp., Pittsburgh, Pa. (USA)). 1975. 3p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

An experimental study was made of the self-welding of various combinations of FBR materials (304 ss, Inconel 718, A286, Stellite 156, and Stellite 6) in sodium at 800 to 1100°F for time periods up to 6 months and contact stresses of 2 to 148 ksi. Stresses required to separate the surfaces were determined. Self-welding was observed only at temperatures of 1050°F and above, with the breakaway force being less than 5 ksi. (DLC)

**12572** (JAERI-M-5946) CORROSION OF AISI 316 AND AISI 304 STAINLESS STEEL WITH IODINE VAPOR. Fukuda, T.; Omori, S. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 24p. (In Japanese). INIS.

The weight loss of stainless steel in corrosion with iodine vapor has been studied in a temperature range of 500 ~ 1000°C and an iodine vapor pressure range of 0.05 ~ 0.5 mmHg, using a thermobalance. In the initial stage of corrosion, the weight loss rate is largely influenced by solution treatment or surface treatment; the induction period, observed for solution-treated samples, is shortened or disappeared by fission-fragment irradiation, ion-bombardment, or mechanical polishing, and in some cases corrosion is even accelerated by the surface treatments. A constant weight loss region follows the initial stage of corrosion. In this region, the weight loss rate is not dependent on treatment to the samples, and has a linear relationship with the vapor pressure of iodine. The rate is the largest at about 800 and 750°C for AISI 316 and AISI 304 stainless steel. The rates in general are larger for AISI 304 than for AISI 316 stainless steel below 700°C but almost the same above 800°C. Corrosion product layer is observed on the surface of the sample below 700°C. Based on these findings, the corrosion process is discussed. The deposition of corrosion product in a temperature gradient tube is also described. (auth)

**12573** (RFP-2351) CORROSION-INDUCED ACOUSTIC EMISSIONS FROM URANIUM 4.5-WEIGHT PERCENT NIOBIUM BINARY ALLOY. Mah, R.; Kochen, R. L.; Macki, J. M. (Atomics International Div., Golden, Colo. (USA)). 15 Dec 1975. Contract E(29-2)-3533. 10p. Dep. NTIS $4.00.

The ability to monitor corrosion and stress-corrosion cracking of uranium 4.5-weight percent niobium was investigated. The acoustic emissions from stress-corrosion cracking were monitored using smooth four-point bend specimens, which were immersed in oxygen-saturated water containing chloride ions. The acoustic emissions from corrosion were monitored from rectangular corrosion coupons. These latter specimens were exposed to nitrogen-saturated and oxygen-saturated solutions of distilled water and distilled water with chloride ions. Dilute solutions of hydrochloric acid were also used. Findings show that stress-corrosion crack monitoring of the alloy was successful. Corrosion monitoring of the alloy showed a direct correlation between corrosion rate (based on weight loss) and total acoustic emissions. For a specific range, one can calculate the corrosion rate of uranium alloys in a corrosive solution from the total acoustic emissions generated. Studies to determine the source of corrosion-induced acoustic emissions were inconclusive.

**12574** (Y-1999) EFFECT OF AGING ON THE GENERAL CORROSION AND STRESS CORROSION CRACKING OF URANIUM–6 WT PERCENT NIOBIUM ALLOY. Koger, J. W.; Ammons, A. M.; Ferguson, J. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 26p. Dep. NTIS $4.00.

Mechanical properties of the uranium-6 wt percent niobium alloy change with aging time and temperature. In general, the ultimate tensile strength and hardness reach a peak, while elongation becomes a minimum at aging temperatures between 400 and 500°C. The first optical evidence of a second phase was in the 400°C-aged alloy, while complete transformation to a two-phase structure was seen in the 600°C-aged alloy. The maximum-strength conditions correlate with the minimum stress corrosion cracking (SCC) resistance. The maximum SCC resistance is found in the as-quenched and 150, 200, and 600°C-aged specimens. The as-quenched and 300°C-aged specimens had the greatest resistance to general corrosion in aqueous chloride solutions; the 600°C-aged specimen had the least resistance. (auth)

**12575** CORROSION AND ELECTROCHEMICAL BEHAVIOR OF INDIUM AND INDIUM–BISMUTH ALLOYS IN HYDROCHLORIC ACID. Wang, Y. M. Rolla, MO; Univ. of Missouri (1975). 79p. University Microfilms Order No. 75-22,312.

Thesis (Ph. D.).

The corrosion of In-Bi alloys was studied using x-ray, scanning electron microscopy, atomic absorption spectroscopy, and cyclic voltammetry techniques. Calculated activation energy values indicated that the corrosion of In-Bi alloys was activation controlled. The effect of amine mixtures on the corrosion of In and $In_2Bi$ ($beta_1$ phase) was studied. Morphological studies revealed that the porosity of the resulting physical surface structure was influential in determining the corrosion rate. In deaerated 3N HCl solutions, the selective dissolution of indium was the predominant mechanism in the corrosion of In-Bi alloys. The corrosion was always accompanied by a phase change on the surface and the corrosion rates of

In-Bi alloys were found to increase in the presence of oxygen. The corrosion potential values indicated that the corrosion of In-Bi alloys was cathodically controlled, and the occurrence of preferential or simultaneous dissolution in In-Bi alloys was also dependent on potential. (Diss. Abstr. Int., B)

**12576** PROCESS FOR SURFACE TREATMENT OF ZIRCONIUM-CONTAINING CLADDING MATERIALS FOR FUEL ELEMENT OR OTHER COMPONENTS FOR NUCLEAR REACTORS. Videm, K. G.; Lunde, L. R.; Kooyman, H. H. (to Institutt for Atomenergi). US Patent 3,909,370. 30 Sep 1975. Filed date 30 Nov 1972. 12p.

A process for the surface treatment of zirconium-base cladding materials for fuel elements or other components for nuclear reactors is described. The treatment includes pickling the cladding material in a fluoride-containing bath, and then applying a protective coating through oxidation to the pickled cladding material. The fluoride-containing contaminants which remain on the surface of the cladding material during pickling are removed or rendered harmless by anodic oxidation. (auth)

**12577** STUDIES IN CORROSION OF Zr-Cu BINARIES AND Zr-Nb-Be TERNARY ALLOYS IN WATER, STEAM AND OXYGEN. Gadiyar, H. S.; Balachandra, J. (Bhabha Atomic Research Centre, Bombay (India). Metallurgy Div.). Indian J. Technol.; 12: No. 5, 211-216(May 1974).

24 refs., 4 figures, 3 tables.

The corrosion and oxidation behaviors of Zr-1 Nb alloy as such and with 0.1, 0.3 and 0.5 wt.% Be additions and Zr-Cu binaries (0.5, 1.0 and 2.0 wt %) have been studied in water at 360°C (saturation pressure), in steam at 550°C (1 atm) and in oxygen at 600°C (1 atm) along with Zircaloy-2 control specimens. Zr-1 Nb alloy has been observed to show low weight gains in water at 360°C, which are comparable to those of Zircaloy-2. A small amount of Be (0.1 wt %) is slightly beneficial in lowering the weight gains. In steam at 550°C and oxygen at 600°C, the oxidation rates are higher as compared with Kroll Zr or Zr-Cu binary alloys, and minor additions of Be (0.1 to 0.3 wt %) slightly improve the oxidation resistance. The studies on Zr-Cu binaries indicate that the addition of more than 0.5 wt % copper is not beneficial (compared with Zircaloy-2) in aqueous system at 360°C. In steam at 550°C and oxygen at 600°C, Zr-0.5 Cu binary alloy shows better oxidation resistance compared with Zr-Nb alloy series or Zircaloy-2. Higher percentages (1 and 2 wt %) have not shown improvement over Zr-0.5 Cu in steam and improve slightly in oxygen. (auth)

**12578** ELECTRON ENERGY LOSS SPECTROSCOPY. Application at the Study of Oxygen Chemisorption on the (100) Molybdenum Face. Lecante, J.; Ballu, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service de Physique Atomique). J. Phys. (Paris), Lett.; 35: No. 12, L.261-L.264(Dec 1974). (In French).

The results of a study of the adsorption of oxygen on the (100) molybdenum face by electron energy loss spectroscopy were described. New transitions appear, which confirm the values obtained by photoemission from the same system. The comparison between the two techniques is extended to other metal-adsorbed gas systems and there is a fair agreement. (FR)

**12579** CORROSION PROBLEMS IN ENERGY CONVERSION AND GENERATION. Symposium Held in New York City, October 15-17, 1974. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974). 479p. (CONF-7410138-).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974).

This book, containing 28 papers, is divided into four parts dealing with corrosion problems in electrochemical energy conversion, gas turbine technology, advanced energy generation and conversion systems (such as HTGR, MHD, FBR), and modern nuclear technology. Separate abstracts were prepared for nine in NSA scope and for three in ERA scope; five others were indexed for EDB. (DLC)

*For abstracts of individual papers see: 12580-12583, 13926, 13945, 13961, 13966, and 14021.*

**12580** CAUSTIC CRACKING IN HOT AQUEOUS AND SUPERHEATED STEAM ENVIRONMENTS. Indig, M. E. (General Electric Co., San Jose, CA). pp 397-409 of Corrosion Problems in Energy Conversion and Generation. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974). See CONF-7410138-.

Because of the proximity of sodium and water in the LMFBR steam generator, the possibility of caustic cracking exists. A program of caustic cracking of various ferritic and austenitic alloys was initiated in order to help determine the best construction material for the steam generator. The testing environment simulated faulted conditions in the evaporator and the superheated steam sections of the steam generator. Many of the austenitic alloys were found to be susceptible to caustic cracks. At 600°F (evaporator temperature), cracking was found in samples of Carpenter 20 Cb 3, Armco 22-13-5, Type 304 stainless steel, and Incoloy 800 in 3 percent caustic. Inconel 600 failed when stressed below yield in caustic-contaminated steam at 900°F (superheater temperature). The 2¼ Cr-1 Mo steel was found extremely resistant to caustic cracking and has been chosen as the material of construction for the stream generator. 12 fig, 5 tables. (auth)

**12581** STRESS CORROSION CRACKING BEHAVIOR OF NEWER IRON-CHROMIUM-NICKEL ALLOYS AT 550°F IN HIGH PURITY WATER. Clarke, W. L.; Danka, J. C.; Gordon, G. M. (General Electric Co., San Jose, CA). pp 410-422 of Corrosion Problems in Energy Conversion and Generation. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974). See CONF-7410138-.

As part of a long range materials development program, new commercial plant materials were evaluated for future BWR applications. These materials include ferritic, martensitic, austenitic, and austeno-ferritic stainless steels. Each alloy was characterized for chemical composition, microstructure, and mechanical properties. Stress corrosion cracking screening tests were performed in 550°F, high-purity water containing 36 ppM oxygen on uniaxial tensile specimens stressed at 75 percent of the 550°F ultimate tensile strength. Tests were continued to 5000 hours or failure which ever occurred first. Post-test metallographic examinations were performed on the failed specimen. Results of the evaluation program are presented. 12 fig, 3 tables. (auth)

**12582** STRESS CORROSION CRACKING IN HIGH PURITY WATER. Pement, P. W. (Westinghouse Research Labs., Pittsburgh); Graham, N. A. pp 423-441 of Corrosion Problems in Energy Conversion and Generation. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974). See CONF-7410138-.

A 16,000-hour test in deionized, neutral, deoxygenated water at 630°F (330°C) was conducted on 180 stress corrosion specimens of Inconel 600 prepared from 4 heats and exposed as U-bands, bent beams, and C-rings at sub-yield stresses and with plastic deformation. Commercial heat treatments and solution annealed conditions with and without acid pickled surfaces were included. Intergranular attack occurred sporadically only if pickled or if mechanically worked except for slight attack on 2 solution annealed U-bends. It is concluded that non-pickled Inconel 600 in commercially important microstructures at engineering stresses does not suffer intergranular stress corrosion cracking in extended exposure to high-purity water at elevated temperatures as high as 330°C. (auth)

**12583** EFFECTS OF VARIATIONS OF CARBON, SULFUR, AND PHOSPHORUS ON THE CORROSION BEHAVIOR OF ALLOY 600. McIlree, A. R.; Michels, H. T.; Morris, P. E. (International Nickel Co., Inc., Suffern, NY). pp 442-464 of Corrosion Problems in Energy Conversion and Generation. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974). See CONF-7410138-.

Corrosion tests were conducted on a series of Ni-Cr-Fe heats with C, S, and P varied within the composition range of alloy 600. The materials were in several conditions of heat treatment. Stress corrosion cracking (SCC) tests were conducted in undeaerated and deaerated water and deaerated 50 percent NaOH, all at 316°C (600°F). Intergranular corrosion tests were conducted in boiling 65 percent nitric acid and ferric sulfate-sulfuric acid solutions. In 8000-hour deaerated water tests all materials were resistant to stress corrosion cracking. In undeaerated water and in deaerated 50 percent NaOH, all materials showed intergranular attack. Corrosion rates in boiling 65 percent nitric acid and ferric sulfate-50 percent sulfuric acid increased with increased carbon and sulfur levels. Some of the test coupons corroded uniformly and intergranularly during the ferric sulfate-50 percent sulfuric acid exposure. Reducing the sulfuric acid concentration and increasing the ferric sulfate concentration caused intergranular corrosion of carbon- and phosphorus-containing materials while sulfur acted to decrease the deleterious effects of carbon and

phosphorus. In addition, a grain size effect was revealed in the ferric sulfate–50 percent sulfuric acid exposure. Structural investigations showed carbon and phosphorus could be redistributed by heat treatment and were generally associated with $M_7C_3$ and Ti(C,N) particles. High sulfur heats contained sulfur-rich particles which were located both within the grain and on grain boundaries. The way in which these residual elements influence intergranular corrosion is discussed. 6 fig, 7 tables. (auth)

## Preparation and Fabrication

*Refer also to abstract 11585.*

**12584** (UNI-187) BRAZE RING QUALIFICATION PROGRAM. Bowles, K. C.; Tosdale, J. P. (United Nuclear Industries, Inc., Richland, Wash. (USA)). 1975. Contract AT(45-1)-1857. 5p. Dep. NTIS $3.50.

This document defines the requirements for the formal qualification of a vendor for the fabrication of braze rings, as defined in Paragraph 600 of UNI Specification HWS-8853, "Zircaloy-2 Beryllium Braze Ring Specification." (DLC)

**12585** (Y-DA-6295) MACHINABILITY ASPECTS OF DIAMOND-TURNED METAL OPTICS. Arnold, J. B.; Steger, P. J.; Morris, T. O. (Oak Ridge Y-12 Plant, Tenn. (USA)). 12 Dec. 1975. Contract W-7405-eng-26. 22p. Dep. NTIS $4.50. (CONF-750852-4).

Work that was done to gather machinability data in order to better understand the mechanics of the diamond-turning process is described. Basic force data have been measured for the most common metals used in optical fabrication (electroplated gold, silver, OFHC copper, and 6061-T6 aluminum). In addition, force and surface deformation data were gathered on large and small-grained electroplated copper and electroplated nickel. Residual stress was measured as a function of the depth of cut in order to begin to understand how the history of the machining process could influence surface quality. (auth)

**12586** DEVELOPMENT OF A TECHNOLOGY FOR PRODUCING CHROMIUM–CADMIUM BRONZE. Rokhov, I.; Shchipkov, P.; V'lchev, K.; Tsenkin, G. God. Nauchnoizsled. Inst. Tsvetna Metal., Plovdi; 9: 63-71(1971). (In Bulgarian).

Existing methods of producing Cr–Cd bronze are discussed, and a new technology, more economical in power consumption and material losses is described. It is technologically and economically undesirable to melt the constituent metals together under flux since their physico-chemical properties are insufficiently compatible; severe losses are encountered by this method and the Cr in particular is not properly assimilated by the Cu. The adoption of an alumino-thermal technique (thermit process) gives better results. Examples of the production of Cu–Cr and Cu–Cr–Cd alloys by the proposed methods are presented. (Metals Abstr.)

**12587** CALCULATION OF THE RATE OF EVAPORATION IN THE VACUUM DISTILLATION OF CADMIUM. Popov, D.; Rokhov, I.; Nikovski, N. God. Nauchnoizsled. Inst. Tsvetna Metal., Plovdi; 10: 105-113(1972). (In Bulgarian).

Shortcomings in the method of calculating rates of evaporation in the vacuum distillation of metals by means of the Langmuir equation are considered; errors arise because the geometry of the apparatus and certain physico-chemical properties of the distillate are not taken into account. Ways of correcting for these errors are proposed and the rate of evaporation in the vacuum distillation of Cd is calculated. Under typical conditions a rate of 0.01 $g/cm^2 \cdot s$ at 450°C is calculated; this figure agrees closely with experiment. (Metals Abstr.)

**12588** CORRELATION BETWEEN MACHINABILITY AND METALLOGRAPHIC STRUCTURE IN AN ALLOY STEEL 38CrAlMo7 [UNI 6120-67]. Gatti, L.; Cibaldi, C.; Morelli, D. Riv. Mecc.; 26: No. 586, 15-24(Jan 1975). (In Italian).

Specimens of alloy steel UNI6120-67 were subjected to various heat treatments, e.g., full annealing, normalizing, normalizing and tempering, and hardening and tempering at various temperatures. The machinability in each condition was related to the microstructure. Results show that best machinability was achieved by hardening and tempering at 750°C. Annealed structures were practically unmachinable. (Metals Abstr.)

**12589** LIQUID SINTERED COBALT-RARE EARTH INTERMETALLIC PRODUCT. Benz, M. G. (to General Electric Co.). US Patent 3,919,004. 11 Nov 1975. Filed date 15 Feb 1974. 14p.

A process is described for preparing novel sintered cobalt–rare earth intermetallic products which can be magnetized to form permanent magnets having stable improved magnetic properties. A particulate mixture is formed of a base CoR alloy and an additive CoR alloy, where R is a rare earth metal. The base CoR alloy is one which, at sintering temperature, exists as a solid $Co_5R$ intermetallic single phase. The additive CoR alloy is richer in rare earth metal than the base CoR alloy, and at sintering temperature is at least partly liquid. The base and additive alloys, in particulate form, are each used in an amount to form a mixture which has a cobalt and rare earth metal content substantially corresponding to that of the final desired sintered product. The mixture is pressed into compacts and sintered to the desired sintered product phase composition and density. At sintering temperature, the final sintered product has a phase composition lying outside the $Co_5R$ single phase on the rare earth richer side. Specifically, the final sintered product contains a major amount of the $Co_5R$ solid intermetallic phase and up to about 35 percent of the product of a second solid CoR intermetallic phase which is richer in rare earth content than the $Co_5R$ phase. (auth)

**12590** SINTERED COBALT-RARE EARTH INTERMETALLIC PRODUCT. Benz, M. G. (to General Electric Co.). US Patent 3,919,003. 11 Nov 1975. Filed date 11 Feb 1974. 10p.

This patent describes a sintered product having substantially stable permanent magnet properties in air at room temperature. It comprises compacted particulate cobalt–rare earth alloy consisting essentially of a $Co_5R$ intermetallic phase and a CoR intermetallic phase which is richer in rare earth metal content than the $Co_5R$ phase, where R is a rare earth metal. The $Co_5R$ intermetallic phase is present in an amount of at least 65 percent by weight of the sintered product and the CoR intermetallic phase which is richer in rare earth metal content than the $Co_5R$ phase is present in a positive amount having a value ranging up to about 35 percent by weight of the product. The sintered product has a density of at least 87 percent and has pores which are substantially noninterconnecting and wherein the component grains have an average size less than 30 microns. (Official Gazette)

**12591** SINTERED COBALT-RARE EARTH INTERMETALLIC PRODUCT. Benz, M. D. (to General Electric Co.). US Patent 3,919,002. 11 Nov 1975. Filed Date 11 Feb 1974. 10p.

A process is described for preparing novel sintered cobalt–rare earth intermetallic products which can be magnetized to form permanent magnets having stable improved magnetic properties. A cobalt–rare earth metal alloy is formed having a composition which at sintering temperature falls outside the composition covered by the single $Co_5R$ intermetallic phase on the rare earth richer side. The alloy contains a major amount of the $Co_5R$ intermetallic phase and a second solid CoR phase which is richer in rare earth metal content than the $Co_5R$ phase. The specific cobalt and rare earth metal content of the alloy is substantially the same as that desired in the sintered product. The alloy, in particulate form, is pressed into compacts and sintered to the desired density. The sintered product is comprised of a major amount of the $Co_5R$ solid intermetallic phase and up to about 35% of the product of the second solid CoR intermetallic phase which is richer in rare earth metal content than the $Co_5R$ phase. (Official Gazette)

**12592** RADIOISOTOPE STUDY OF THE DISTRIBUTION OF ZINC AND SILVER DURING THE INTENSIVE ZONE REFINING OF CADMIUM. Popov, D.; Nikovski, N.; Shipkova, N.; Karaalanov, A.; Sotirova, T. God. Nauchnoizsled. Inst. Tsvetna Metal., Plovdiv; 9: 95-103(1971). (In Bulgarian).

The movement of Zn and Ag during the intensive zone refining of Cd was studied by a radio-isotope method ($^{110}Ag$ and $^{65}Zn$). The separation of impurities was aided by agitating the molten zone with an electromagnetic field. Many of the impurities commonly encountered in Cd were rapidly eliminated in weak electromagnetic fields, but the effect on the distribution of Zn and Ag was slight. On increasing the field strength this effect rapidly intensified, and the normally reluctant Zn and Ag impurities passed easily from the refined section. The disappearance of the impurities was clearly revealed by recording a succession of autoradiographs. (Metals Abstr.)

**12593** ZIRCONIUM ALLOYS. Frenkel, J. M.; Pelchat, J.; Weisz, M. (to Commissariat a l'Energie Atomique). French Patent 2,219,978/A/. 2 Mar 1973. 6p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A method is described for the preparation of nuclear reactor components such as fuel cans and pressure-tubes of zirconium alloys. The method is characterized in that use is made of zirconium alloys with from 0.16 to 0.25% oxygen, by weight, and in that these elements are submitted to an annealing operation, at a temperature of from 400 to 750°C. The thus obtained structural elements are used in water cooled nuclear reactors. (FR)

**12594** GROWTH OF NIOBIUM SINGLE CRYSTALS BY PULLING FROM A MELT ON A PEDESTAL. II. Growth of Dis-

location-Free Crystals. Naramoto, H.; Kamada, K. (Japan Atomic Energy Research Institute, Tokai, Ibaraki, Japan). J. Cryst. Growth; 30: No. 2, 145-150(Sep 1975).

The following improvements were made in growing niobium single crystals by pulling from a melt in a pedestal heated by electron beam bombardment: (1) use of single crystalline seed; (2) rotation of the seed crystal as well as the pedestal; and (3) reduction of the pulling rate down to about 0.15 mm/min. The perfection of these crystals was assessed by taking both projection and section topographs under both the thick crystal case and thin crystal case. In the former case, diffusion of defect-images, which might overlook the grown-in dislocations, was critically examined. As a result of these measurements it was established that the niobium crystals are free from any grown-in dislocations. No propagation of dislocations from the seed to the grown crystal was observed. (NL)

**12595** EPITAXIAL GROWTH OF TANTALUM DEPOSITS ON TANTALUM DURING THERMAL DECOMPOSITION OF GASEOUS CHLORIDE. Piquard, G.; Caradec, J.-Y.; Weber, B. (Centre National de la Recherche Scientifique, 54-Villers-les-Nancy (France). Centre de Cinetique Physique et Chimique). J. Cryst. Growth; 29: No. 3, 367-372(Jul 1975). (In French)

Results of an experimental study of epitaxial growth of tantalum on tantalum surfaces close to Ta (100) are presented. These coatings were obtained in a high vacuum system by tantalum pentachloride pyrolysis at low pressure (approximately $10^{-4}$ Torr) and high temperature (1500-2000°C). Such coherent coatings are in strict epitaxial relation with the substrate, presenting the same grain limits and superficial topography of the underlayer. (NL)

## *Properties, Structure, and Phase Studies*

*Refer also to abstracts 11688, 12670, 12904, 13029, 13582, 13921, 13987, 13997, 13998, 14118, and 14124.*

**12596** (AECL-5226, pp 47-48) CALCULATIONS FOR Nb–Mo ALLOYS. Powell, B. M.; Martel, P.; Woods, A. D. B. Aug 1975.

In physics division progress report, April 1–Jun 30, 1975.

**12597** (AECL-5226, pp 48-49) EXCITATIONS IN $PrAl_2$. Svensson, E. C.; Holden, T. M.; Buyers, W. J. L.; Purwins, H. G. (Univ., Geneva). Aug 1975.

In physics division progress report, April 1–June 30, 1975.

**12598** (AECL-5246) GRADIENT APPROXIMATION FOR CALCULATING DEBYE TEMPERATURES FROM PAIRWISE INTERATOMIC POTENTIALS. Jackson, D. P. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Sep 1975. 12p. Dep. NTIS (US Sales Only) $4.50 AECL $0.50.

A simple gradient approximation is given for calculating the effective Debye temperature of a cubic crystal from central pairwise interatomic potentials. For examples of the Morse potential applied to cubic metals the results are in generally good agreement with experiment. (auth)

**12599** (BMI-1939) CRITICAL EXPERIMENTS, MEASUREMENTS AND ANALYSES TO ESTABLISH A CRACK ARREST METHODOLOGY FOR NUCLEAR PRESSURE VESSEL STEELS. Fourth Quarterly Progress Report, Task 62. Hahn, G. T.; Gehlen, P. C.; Hoagland, R. G.; Kanninen, M. F.; Popelar, C.; Rosenfield, A. R. (Battelle Columbus Labs., Ohio (USA)). Nov 1975. Contract W-7405-eng-92. vp. Dep. NTIS $5.45.

A two-dimensional, finite-difference, dynamic analysis of crack propagation and arrest is developed. The analysis has been applied to the wedge-loaded rectangular DCB specimen. Preliminary results of the two-dimensional analysis, particularly the crack velocity-arrest length relation, are very similar to those previously obtained with the one-dimensional treatment. Two critical tests of the dynamic/energy conservation analysis of crack arrest were performed. Measurements of crack propagation and arrest in Homalite-100 performed at the University of Washington have been compared with one-dimensional calculations employing the K/sub D/-velocity dependence of this material measured independently at the University of Maryland. The calculation results are in good accord with the measurements of crack speed, arrest length, and the local stress intensity. In addition, measurements of crack propagation and arrest in wedge- and machine-loaded, contoured DCB specimens of AISI 4340 are compared with calculation results using the K/sub D/(V) previously derived from wedge-loaded rectangular DCB-test pieces. Results of these experiments support the view that K/sub D/(V) is geometry and loading independent. Efforts to develop a testing procedure were centered on the LEFM size requirements for rectangular-DCB test pieces. (auth)

**12600** (CEA-R-4711) SOLUTE DIFFUSION AT INFINITE DILUTION IN CUBIC PHASES OF PLUTONIUM. Charissoux, C. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Etudes des Combustibles a Base de Plutonium). Thesis. Submitted to Paris Univ., Orsay, France.

The solute diffusion mechanism of cobalt in δ (fcc) and ε (bcc) phases of plutonium is the same in both phases: direct interstitial mechanism of the dissociative type. Gold and silver diffuse in the ε phase by the same mechanism. In this phase, the comparison between the solute diffusion coefficients of cobalt, gold, and silver, and the self-diffusion coefficients of Pu confirmed the activated interstitial model which had been proposed for self diffusion. In the δ phase, this comparison is consistent with a vacancy mechanism for the self diffusion of plutonium. (auth)

**12601** (CONF-751144-1) CRACK GROWTH AND CREEP-FATIGUE INTERACTION BEHAVIOR OF $2^1/_4$ Cr–1 Mo STEEL. Brinkman, C. R. (Oak Ridge National Lab., Tenn. (USA)). 1975. 20p. Dep. NTIS $4.50.

From Nuclear Regulatory Commission information meeting; Germantown, Maryland, USA (11 Nov 1975).

Cyclic strain-controlled fatigue tests and cyclic tension-tension crack growth tests employing precracked specimens are being conducted at RT to 593°C in various environments including air, steam, vacuum, and impure He. Fatigue and creep-fatigue data at 482 and 538°C, effects of temperature, waveform, and hold time or strain rate of fatigue life; comparisons with linear damage rule; subcritical crack growth tests; effects of variation of min to max load ratio; and effects of environment (air, steam, He) on crack growth are given. 15 figures. (DLC)

**12602** (CONF-751212-3) MODE SOFTENING AND HIGH SUPERCONDUCTING TRANSITION TEMPERATURE IN SOME A-15 COMPOUNDS. Knapp, G. S.; Bader, S. D.; Fisk, Z. (Argonne National Lab., Ill. (USA); California Univ., San Diego (USA)). 1975. 7p. Dep. NTIS $4.50.

From international conference on low lying lattice vibrational models and their relationship to superconductivity and ferroelectricity; San Juan, Puerto Rico (1 Dec 1975).

The electronic density of states at the Fermi level, N(E/sub F/), and the geometric mean phonon frequencies, omega/sub g/, were determined from heat-capacity data for a number of A-15 superconductors. Although omega/sub g/ is an appropriate average phonon parameter for evaluating McMillan's expression for lambda, it was found that the T/sub c/ values cannot be reliably estimated using omega/sub g/. There are, however, strong correlations between lambda, N(E/sub F/), and the temperature dependence of omega/sub g/, dln omega/sub g//dT. The high-T/sub c/, high-N(E/sub F/) materials $V_3Si$ and $V_3Ga$ show the largest phonon-mode softening on cooling. It is proposed that, for the higher-N(E/sub F/) materials, particular phonon-modes strongly couple to the electronic system and enhance T/sub c/ to a greater extent than average phonon properties would indicate. (auth)

**12603** (CONF-751212-4) EFFECT OF SHARP STRUCTURE IN THE ELECTRONIC DENSITY OF STATES ON THE ELECTRON-PHOTON COUPLING IN HIGH T/sub c/ SUPERCONDUCTORS. Fradin, F. Y. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 7p. Dep. NTIS $4.50.

From international conference on low lying lattice vibrational models and their relationship to superconductivity and ferroelectricity; San Juan, Puerto Rico (1 Dec 1975).

The evidence for sharp structure in the electronic density of states N(epsilon) of certain classes of high T/sub c/ superconductors is based on the normal state temperature dependence of the spin susceptibility chi, electronic specific-heat coefficient gamma, electrical resistivity rho, and nuclear spin-lattice relaxation rate $1/T_1$. Model calculations of chi, gamma, rho, and $T_1$ in the rigid N(epsilon) approximation and of chi and gamma for a temperature dependent N(epsilon) are presented for $V_3Ga$ and $V_3Si$. The model calculations were used to calculate the explicit temperature dependence of the electron mass enhancement and the renormalized electronic specific heat coefficient. The temperature dependence of the dielectric screening, which can have an important effect on renormalizing the phonon frequencies at low temperatures, is also discussed. (auth)

**12604** (COO-1676-39) DISLOCATION-SOLUTE ATOM INTERACTIONS IN ALLOYS. Technical Progress Report, February 1, 1975–January 31, 1976. Gibala, R.; Sethi, V. K.; Fournier, R. (Case Western Reserve Univ., Cleveland, Ohio (USA). Dept. of Metallurgy and Materials Science). 31 Oct 1975. Contract AT(11-1)-1676. 27p. Dep. NTIS $5.00.

New results were obtained in two major project areas: (1) surface oxide softening and solute gradients in niobium and tantalum, and (2) mechanical properties of Nb–H and Nb–D alloys. The important results include: (a) observation and characterization of an extremely large softening and ductilizing effect of bcc metals (niobium and tantalum) by application of thin (500 to 1000 A) oxide films coupled with injection of a high density of mobile dislocations; (b) determination of the relative strengthening ductility changes caused by hydrogen and deuterium in niobium. (auth)

**12605** (COO-3150-37) COMMENTS ON RFSE IN CYLINDERS. Baer, D. R. (Cornell Univ., Ithaca, N.Y. (USA). Lab. of Atomic and Solid State Physics). Oct 1975. Contract AT(11-1)-3150. 11p. Dep. NTIS $4.50.

Field and angle derivatives of the surface impedance have been measured for tungsten and potassium cylinders. Several observations are presented. (auth)

**12606** (IS-M-55) KONDO EFFECT IN Y-RICH ALLOYS CONTAINING A Ce IMPURITY. Petersen, T. S.; Legvold, S.; Burgardt, P. (Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA). Dept. of Physics). 1975. 14p. (CONF-751209-12). Dep. NTIS $4.50.

From 21st annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

Sugawara et al. have found that Ce impurities in some nonmagnetic rare earth hosts exhibit the Kondo effect. Maple and Wittig have shown that when pressure is applied to Y–Ce, the Kondo effect disappears, assumedly because the 4f level is driven from below to above the Fermi level. In the work reported here, alloy hosts of Y/sub x/La/sub 1-x/ are used to get the slope of the Kondo resistivity as a function of atomic volume for samples containing 2 atomic percent Ce impurity. The slope of the rho vs ln T, (d rho/d lnT) varies markedly with atomic volume and shows a sharp peak near x equals 0.95. Furthermore, by using Y–Lu host alloys the Kondo effect will disappear at the atomic volume calculated for the Maple and Wittig result. (auth)

**12607** (KFTI-74-14) ON CRITICAL PARAMETERS OF THE AMORPHOUS METAL FILMS. Kuz'menko, V. M.; Lazarev, B. G.; Mel'nikov, V. I.; Sudovtsov, A. I. (AN Ukrainskoj SSR, Kharkov. Fiziko-Tekhnicheskij Inst.). 1974. 47p. (In Russian). INIS.

18 figs.; 69 refs.

The stability of amorphous modifications of the metals Bi, Ga, Be, Fe, and Yb in films obtained by condensation of their vapors on liquid-helium cooled substrates was studied. For studying the metals, a group of parameters of phase transition from the amorphous to the crystalline state was obtained—critical thickness, critical temperature, and critical magnetic field. A qualitative thermodynamic explanation of the majority of the phenomena studied is presented, based on the energy levels of the condensate-substrate system considered. (tr-auth)

**12608** (LBL-4105) OXYGEN STABILIZED RARE-EARTH IRON INTERMETALLIC COMPOUNDS. Dariel, M. P.; Malekzadeh, M.; Pickus, M. R. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-ENG-48. 10p. (CONF-751209-20). Dep. NTIS $3.50.

From 21st annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

A new, oxygen-stabilized intermetallic compound was identified in sintered, pre-alloyed rare-earth iron powder samples. Its composition corresponds to formula $R_{12}Fe_{32}O_2$ and its crystal structure belongs to space group Im3m. The presence of these compounds was observed, so far, in several R–Fe–O systems, with R equals Gd, Tb, Dy, Ho, Er, and Y. (auth)

**12609** (ORNL-5086) USE OF INSTRUMENTED CHARPY TESTS TO DETERMINE ONSET OF UPPER-SHELF ENERGY. Canonico, D. A.; Stelzman, W. J.; Berggren, R. G.; Nanstad, R. K. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 18p. Dep. NTIS $4.00.

The Charpy V-notch (C/sub v/) upper-shelf energy is usually defined as that temperature range in which the surface of the C/sub v/ specimen exhibits an appearance indicative of a 100 percent ductile fracture. In an attempt to avoid the need for interpretation, the selection of the C/sub v/ upper-shelf energy is based on the results from an instrumented impact test which provides a permanent record of the load-deflection history of a C/sub v/ specimen during the testing sequence. In the brittle-ductile transition temperature regime, a precipitous drop in the load trace occurs. The amount of the drop decreases at higher temperatures until it is zero, and the zero-drop-in-load temperature is identical to the onset of the C/sub v/ upper shelf. This relationship between the drop in load and energy in an instrumented impact test provides incontestable assurance that the C/sub v/ upper shelf has been obtained. This relationship between drop in load and temperature permits a prediction of the onset of the upper-shelf temperature with as few as two instrumented impact tests. It is also shown that nil-ductility temperature (NDT) (determined by the drop-weight test) is released to the C/sub v/ upper shelf. For the SA-508 Class 2 and SA-533 Grade B Class 1 steels employed in the fabrication of pressure vessels for light-water reactors, C/sub v/ testing at NDT + 180°F (100°C) will provide upper-shelf energy values. (DLC)

**12610** (ORNL-TM-5192) RESIDUAL COLD WORK AND ITS INFLUENCE ON TENSILE AND CREEP PROPERTIES OF TYPES 304 AND 316 STAINLESS STEEL. Sikka, V. K.; Swindeman, R. W.; Brinkman, C. R.; Booker, M. K. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 26p. AT.

Tensile and creep properties of types 304 and 316 stainless steel in the as-received (mill-annealed) and reannealed (laboratory-annealed) conditions were related by P/sub RA/ equals A + BP/sub AR/, where P/sub RA/ and P/sub AR/ are properties in reannealed and as-received conditions, respectively, and A and B are material constants. Constant B was shown to give a measure of change in tensile properties due to grain size differences, whereas A, although related to grain size, primarily gave a measure of cold work. The mill-annealed condition of plate and pipe products of types 304 and 316 stainless steel showed 3 to 4 percent residual cold work presumably resulting from bending and straightening operations, as opposed to approximately 10 percent for the bar product of type 316 stainless steel. The changes in creep properties on reannealing were shown to be consistent with corresponding changes observed in yield strength and grain sizes. Constants A and B are summarized for tensile and creep properties of plate, pipe, and bar products of types 304 and 316 stainless steel. 12 figures. (auth)

**12611** (UCRL-51244(Rev.1)) LITERATURE STUDY OF METALLIC TERNARY AND QUATERNARY HYDRIDES. Newkirk, H. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 19 Sep 1975. Contract W-7405-Eng-48. 33p. Dep. NTIS $4.00.

Metallic hydrides are being considered as an attractive solution to storage problems involved in using hydrogen as an alternative fuel. In this application, the unclassified literature was surveyed to find metallic ternary hydride systems of the type MM'H/sub x/; M is a transition element, a member of the rare earth element series, or a member of the actinide element series, and M' is a transition element. Reported quaternary hydrides of the same metallic element series were also reviewed. The hydride-forming systems found and some of their most interesting properties are summarized. Recent advances in the understanding of the absorption characteristics and the stability of these hydride materials are reviewed. (auth)

**12612** (UCRL-Trans-10734) PHASE TRANSFORMATIONS IN URANIUM--VANADIUM ALLOYS: INFLUENCE OF THE CARBON CONTENT. Collot, C.; Couterne, A.; Guillaume, C.; Giraud-Heraud, F.; Guillaumin, J. Translated from J. Nucl. Mater.; 43: 28-50(1972). 40p. Dep. NTIS $5.00.

Results of a study of the refinement of U–V alloys with low V contents (from 0.1 to 1 percent) are presented. The kinetics of the U/sub beta/ yields U/sub alpha/ transformation, which determines the size of the alpha grains, are very sensitive to the carbon content. Microdiffraction analysis of the precipitates formed in these alloys on cooling gives evidence of a V–C type of interaction in the solid phase, the characteristics of which are given. The transformation curves, which were obtained for different V and C contents, show that the latter element can not only deplete the beta matrix in V through the formation of carbides $V_2C$ or with a formula intermediate between $V_2C$ and VC, but can also affect the intrinsic stability of the (U,V)/sub beta/ solution. The refinement of the alpha grain in the U–V alloys is controlled by a set of parameters, each of which has a more or less important influence. These are in particular: the V content–the C content, but not through the effect of carbide particles on the heterogeneous germination of the alpha phase–the solidification rate, which mainly determines the size of the gamma grain, then that of the beta grain, i.e. the kinetics of the U/sub beta/ yields U/sub alpha/ reaction. (auth)

**12613** (UCRL-Trans-10976) FORMATION OF ZONES OF INCREASED DUCTILITY IN A URANIUM ALLOY WITH 0.2 PERCENT BY WEIGHT OF VANADIUM FRACTURED BY TENSION UNDER HYDROSTATIC PRESSURE. Auger, J. P. Translated from C. R. Hebd. Seances Acad. Sci., Ser. C; 281: No. 2/3, 95-98(21 Jul 1975). 8p. Dep. NTIS $4.50.

The fracture mechanism of various states of the alloy U–V 0.2 percent is modified by the application of a hydrostatic pres-

sure during the tensile test. In particular, zones appear in which the metal is very elongated. The fractographic appearance of these zones is described. A deformation and breaking model is proposed. (auth)

**12614** STUDY ON THE PHASE DIAGRAM IN THE ALUMINUM CORNER OF THE ALUMINUM–COPPER–INDIUM ALLOY SYSTEM. Watanabe, H.; Okamoto, T.; Kono, N.; Kato, M. Keikinzoku; 24: No. 9, 418-426(Sep 1974). (In Japanese).

The mechanism of the suppression of ageing by In in the Al–Cu–In alloy system was investigated. The phase constitution of the Al corner of the Al–Cu–In system was examined by thermal and x-ray diffraction analysis and by microscopical observations. At various solution-treating temperatures (520, 500, 480, and 460°C), the solubility of Cu in the $\alpha$-phase was decreased slightly by the addition of In. (Metals Abstr.)

**12615** CONNECTION BETWEEN THE TENDENCY TO BRITTLENESS AND THE $K_y$ COEFFICIENT IN THE PETCH–HALL EQUATION FOR ARMCO IRON MICRO-ALLOYED WITH RARE EARTH METALS. Gurashev, V. N.; Dubinsky, V. N. Uch. Zap. Gor'k. Gos. Univ.; 167: 151-155(1973). (In Russian)

Studies were made of the effects of micro-alloying Armco-Fe with Y, Pr, and Nd on the YS, the $K_y$ coefficient in the Petch–Hall equation, the brittle temperature $T_{br}$, the energy of nucleation, and the crack propagation during impact testing, and the relative microhardness $\Delta H$($\Delta H$ = the difference in microhardness between the boundary and the body of the grain). Micro-alloying with these elements lowers $K_y$, $\Delta H$, and $T_{br}$ but raises the crack propagation energy. The correlation found between $K_y$, $\Delta H$, and the tendency to brittle fracture is explained by the dependence of the latter on $\Delta H$. (Metals Abstr.)

**12616** PHASE TRANSFORMATIONS IN SPLAT COOLED BETA PHASE Ag–Cd AND Cu–Ga ALLOYS. Misra, A. K. Brooklyn; Polytechnic Inst. of New York (1975). 145p. University Microfilms Order No. 75-21,388.

Thesis (Ph. D.).

The morphology and crystallography of martensites occurring in splat cooled beta AgCd and beta CuGa alloys have been studied by utilizing electron diffraction and transmission electron microscopy. Ag-50 at. percent Cd and Cu-Ga alloys of compositions 21, 23.1, 23.7, 25 and 26.5 at. percent Ga were liquid quenched, to room temperature, using a modified gun technique. Anomalous contrast and diffraction effects have been observed in retained beta AgCd phase. These effects have been traced to the instability of the beta phase due to short wavelength lattice vibration modes and to the presence of "omega" phase. A diffusionless martensitic transformation, at room temperature, in the AgCd system has been observed for the first time. Martensites with close packed structures have been observed in splat cooled Ag-50 at. percent Cd alloy. The martensites beta' and gamma' have been identified as 3R and 2H variants respectively. alpha' martensite was also observed. Five crystallographically different martensites were found in the Cu-21 to 26.5 at. percent Ga alloys. They are designated as alpha', beta', $beta_1$', gamma', and $zeta_1$'. It was confirmed that these phases excepting $zeta_1$' phase are stacking variants of the M equals 1 structure with a stacking order which can be specified as 1R, 3R and 2H for alpha', beta', and gamma' phases respectively. These martensites have disordered atomic arrangement as has been confirmed by both from the intensity distribution in the basal plane and from the absence of superlattice rows in the electron diffraction patterns which are parallel to the direction of modulation. The $beta_1$' martensite has been found to be an ordered variant. The morphology of the martensite has been identified as plate or lath like. It has also been confirmed that the $zeta_1$' phase corresponds to an ordered "gamma-brass" type structure. The composition dependence of the appearance of these martensites, their relative stability and microstructural features are discussed. (Diss. Abstr. Int., B)

**12617** DUCTILITY RESPONSE OF THREE HIGH-TEMPERATURE MATERIALS TESTED UNDER HYDROSTATIC PRESSURE. Dembowski, P. V.; Pepe, J. Metall. Trans., B; 6B: No. 1, 191-195(Mar 1974).

The pressure-ductility response of Udimet 700, TZM Mo, and Stellite 21 was determined using a Bridgman-Birch hydrostatic pressure system. Reduction in area (RA) for Udimet 700 increased linearly from 20 to 75 percent over a 0 to 25 x $10^8$ N/m$^2$ pressure range. For TZM Mo, RA increased from 60 percent to a limiting value of approximately 95 percent at $10^9$ N/m$^2$. Results for Stellite 21 were erratic and showed no general pressure dependence. Photomicrographs of the deformed materials are given and microstructures are related to deformation behavior. (Metals Abstr.)

**12618** WC-3015 ALLOY (HIGH-TEMPERATURE ALLOY). Alloy Dig.; vp(May 1974).

WC-3015 Nb alloy containing 28 to 30 Hf, 1 to 2 Zr, 13 to 16 W, 0 to 4 Ta, 0 to 5 Ti, 0.07 to 0.33 C, less than or equal to 0.02 N, less than or equal to 0.03 O, less than or equal to 0.001 H was developed for use at high temperature in oxidizing environments. Its composition can be tailored to meet specific requirements. When WC-3015 is exposed to O at elevated temperature, Hf and Nb oxidized preferentially and $HfO_2$ dissolves in $Nb_2O_5$ to form $6HfO\text{-}Nb_2O_5$. This complex oxide has a tight cubic lattice which resists the diffusion of O into the substrate. During 24-h exposure to air at 2400°F, the alloy oxidizes to a depth of approximately 0.035 in. with a surface recession of 0 to 0.004 in. Oxidation resistance of WC-3015 welds and base material can be further enhanced greatly by applying silicide coatings. WC-3015 alloy can be machined by conventional and electrical-discharge methods. It can be hot worked readily by extrusion, forging or rolling. Cold working can be used at room or elevated temperature. It can be welded by the electron-beam or Tig processes. Physical constants, typical mechanical properties at 75 to 2400°F, and effects of composition and heat treatment on tensile and stress-rupture properties of the alloy are tabulated. (Metals Abstr.)

**12619** LaNi/sub 5-x/Pt/sub x/: NMR INVESTIGATION OF STRUCTURAL AND ELECTRONIC PROPERTIES. Weisman, I. D. (National Bureau of Standards, Gaithersburg, MD); Bennett, L. H.; McAlister, A. J.; Watson, R. E. Phys. Rev., B; 11: No. 1, 82-91(1 Jan 1975).

Pt-site Knight shifts kappa, relaxation times, and crystallographic data were obtained for the LaNi/sub 5-x/Pt/sub x/ (0 less than or equal to x less than or equal to 5) system. There are two transition-metal sites: one, A, in a La layer and one, B, between La layers; different kappa's are observed for each site. The system is found to be completely miscible and NMR intensities and crystallographic results show that Pt prefers the B site and that considerable ordering occurs for x less than or equal to 4. The $^{195}$Pt kappa's are approximately 1 percent and approximately 0 percent for the A and B sites, respectively, in $LaPt_5$; the A-site kappa is approximately 0 at $LaNi_4Pt$ and the B-site kappa reaches ~2 percent in $LaNi_{4.75}Pt_{0.25}$. The shifts, taken together with relaxation times, indicate that s-band effects dominate, particularly for the A site, in $LaPt_5$ and that the Pt atoms on both sites become more transition-metal-like with increasing x. Exchange enhancement is shown to be an essential factor at the Ni-rich end. Variations in chemical activity, as in hydride formation, are discussed in light of these electronic differences between $LaNi_5$ and $LaPt_5$. (auth)

**12620** CRYSTAL-FIELD AND CLUSTERING EFFECTS IN THE SPECIFIC HEAT OF Dy IN Pd. Devine, R. A. B.; Jacques, P.; Poirier, M. (Univ. of Montreal). Phys. Rev., B; 11: No. 1, 563-566(1 Jan 1975).

Recent results of specific-heat measurements on dilute alloys of Dy in Pd are reanalyzed. Assuming the ionic ground state found from paramagnetic-resonance measurements, the Schottky-anomaly and cluster contributions are segregated and the crystal-field splitting of the ground and first-excited states is found to be in reasonable agreement with theoretical predictions. The nature of the cluster contribution is discussed and an upper limit to the range of the Ruderman-Kittel-Kasuya-Yosida interaction deduced. (auth)

**12621** STRESS SYSTEMS REQUIRED TO DEFORM A Mo SINGLE CRYSTAL SIMULTANEOUSLY ON TWO ACTIVE COPLANAR SLIP SYSTEMS. Millour, J. P.; Kobylanski, A.; Goux, C. (Ecole Nationale Superieure des Mines, 42- Saint-Etienne (France)). C. R. Hebd. Seances Acad. Sci., Ser. C; 280: No. 14, 937-939 (14 Apr 1975). (In French).

When a (011) plane of a single crystal of molybdenum undergoes a shear stress in whatever direction $\Delta$, the macroscopic shear takes place along a direction $\Delta'$. It can be considered as the result of two shear deformations along (111) directions. The stresses required to produce the shear deformation in the (111) directions depend on the direction of the shear stress and do not obey the law of the critical shear stress. (FR)

**12622** COHERENT AND INCOHERENT DYNAMICAL SCATTERING: APPLICATION TO THE STUDY OF LINE-PATTERNS. Beauvillain, J. (Centre National de la Recherche Scientifique, 31- Toulouse (France). Lab. d'Optique Electronique). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 14, 443-446(14 Apr 1975). (In French).

A wave approach of electron scattering by crystals is presented. A notion of coherence between the Bloch waves components is introduced. The first results, in agreement with the existing theories, permit the interpretation of the contrast of diffraction patterns. (FR)

**12623** RAYLEIGH SOUND WAVE PROPAGATION ON A GALLIUM SINGLE CRYSTAL IN A LIQUID $^3$He BATH. Bellessa, G. (Paris-11 Univ., 91- Orsay (France). Lab. de Physique

des Solides). J. Phys. (Paris), Lett.; 36: No. 5, L.137-L.139 (May 1975).

The observation of the Rayleigh sound wave propagation on a gallium single crystal at frequencies up to 120 MHz and temperatures down to 0.4 K is reported. The velocity and the attenuation are studied at different temperatures. The attenuation of Rayleigh waves by the $^3$He bath is also studied at different temperatures and frequencies. (FR)

**12624** APPLICATION OF QUANTITATIVE DIFFERENTIAL THERMAL ANALYSIS TO THE DETERMINATION OF THE ENTHALPY OF THE $\alpha \rightarrow \beta$ PHASE TRANSITION OF TITANIUM AND ZIRCONIUM. Harmelin, M.; Lehr, P. (Centre National de la Recherche Scientifique, 94- Vitry-sur-Seine (France). Centre d'Etudes de Chimie Metallurgique). C. R. Hebd. Seances Acad. Sci., Ser. C; 280: No. 16, 1011-1014(28 Apr 1975). (In French).

Quantitative differential thermal analysis has been applied to the determination of the enthalpy changes of titanium and zirconium during the transformation of the hexagonal-close-packed $\alpha$-phase to the cubic-body-centered $\beta$-phase. The results are $\Delta H^\circ = 4213\ J \cdot mol^{-1}$ for titanium and $3996\ J \cdot mol^{-1}$ for zirconium. (FR)

**12625** STRUCTURE AND MECHANICAL PROPERTIES OF NIOBIUM-STEEL JOINTS. Kharchenko, G. K.; Ignatenko, A. I.; Shevchuk, T. V.; Gordan, G. N.; Kulak, L. D. (AN Ukrainskoj SSR, Kiev. Inst. Ehlektrosvarki); Fal'chenko, V. M.; Mazanko, V. F. (AN Ukrainskoj SSR, Kiev. Inst. Metallofiziki). Avtomat. Svarka; No. 7, 17-20(Jul 1974). (In Russian).

4 refs.; 4 figs.; 2 tables; for English translation see the journal Autom. Weld.

The growth of the transition zone during heating of the joints from 800 to 1200°C was investigated. The dependence of the mechanical properties of the bimetallic joint on the thickness of the transition zone and its chemical composition was shown. It was shown that during the mechanical testing annealed compounds disintegrated in transition zones containing NbC and $Nb_2C$. Equally strong joints of Nb with stainless steel can be obtained by using a thin Fe interlayer. (tr-auth)

**12626** PHENOMENOLOGICAL STUDY OF THE MICRODEFORMATIONS PRODUCED AT THE BEGINNING OF PRIMARY CREEP UNDER LOW STRESSES IN AN AUSTENITIC STAINLESS STEEL OF Z3CND 18-13 TYPE. Calvet, J. N.; Le Bret, P.; Roulliay, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). Mem. Sci. Rev. Metall.; 72: No. 1, 45-59(Jan 1975). (In French).

From Autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1972).

A creep machine was modified enabling tests to be carried out at 550°C under 8hbar. The modulus of elasticity, yield strength, plastic deformation on loading, creep deformation, and total plastic deformation were determined in an austenitic stainless steel of Z3CND 18-13 type. A relationship was established between the plastic deformation on loading and the creep deformation. (FR)

**12627** STUDY OF CREEP DEFORMATIONS UNDER COMPLEX STRESSES IN AN AUSTENITIC STAINLESS STEEL. Creep Under Progressive Loading at High Temperature. Creep Under Thermal Stresses. Calvet, J. N.; Le Bret, P.; Petrequin, P.; Weisz, M. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service de Recherches Metallurgiques Appliquees). Mem. Sci. Rev. Metall.; 72: No. 1, 29-43(Jan 1975). (In French).

From Autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1972).

Tests were carried out on a superquenched steel Z6CND 17-12 (316) subjected to variable loads at 700°C ($P = Kt$). The K value varies between $0.7 \times 10^{-3}$ and $40 \times 10^{-3}$ kg/mm$^2$/h and the maximum deformation is in the order of 1%. Analysis of the results leads to an empirical method of determining the deformation under progressive loads. The results obtained at 700°C were compared with the curves calculated according to the time-hardening and strain-hardening hypothesis. The strain-hardening hypothesis is the most representative of the deformation mechanism. An approximate method, using the mean rates to obtain a given deformation, is presented. (FR)

**12628** STUDY OF THE INFLUENCE OF BORON ON THE STRUCTURE AND MECHANICAL PROPERTIES OF STABILIZED AUSTENITIC STAINLESS STEELS AT ROOM AND HIGH TEMPERATURES. Bourgeot, J.; Henry, G.; Michaut, B.; Thomas, B.; Tixier, R. (Institut de Recherches de la Siderurgie Francaise (IRSID), 78- Saint-Germain-en-Laye). Mem. Sci. Rev. Metall.; 72: No. 1, 9-27(Jan 1975). (In French).

From Autumn meeting on metallurgy; Chatenay-Malabry, France (2 Oct 1972).

The influence of boron additions on the structural hardening obtained by quenching and tempering and on the creep behavior of stabilized austenitic stainless steels was studied. Boron accelerates the structural hardening and raises the maximum yield strength. It also increases greatly the life at high temperature. The improvement of the mechanical properties is associated with the morphology and the distribution of the Ti or Nb carbides precipitating in the grains during tempering and creep. (FR)

**12629** STAINLESS STEELS FOR CRYOGENIC BOLTS AND NUTS. Leroy, F.; Rabbe, P.; Odin, G. (Societe Creusot-Loire, 75- Paris (France)). Mater. Tech.; 63: No. 3, 93-113(Mar 1975). (In French).

From 1st colloquium on bolting and metallurgy of iron; Lyon, France (17 Apr 1975).

Stainless steel for cryogenic applications are generally austenitic steels which, under the effect of cold-drawing, can or cannot undergo a partial martensitic transformation according to their composition. Very high ductility and endurance characteristics at low temperatures, together with very high yield strength and resistance values, can be attained with grades of nitrogenous steels of types Z2CN18-10N and Z3CMN18-8-6N. Optimum ductility values are obtained by employing to the best possible the martensitic transformations that develop during cold-drawing. From the plotting of the rational traction curves, it is possible to analyse very simply the influence of the composition on the martensitic transformations. (FR)

**12630** ELECTRONIC STRUCTURE AND TEMPERATURE DEPENDENCE OF KINETIC PROPERTIES OF NIOBIUM AT HIGH TEMPERATURES. Peletskii, V. E. (AN SSSR, Moscow. Inst. Vysokikh Temperatur). Rev. Int. Hautes Temp. Refract.; 12: No. 1, 90-92(Jan 1975).

From 4th European conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

The thermal and electric conductivity of Nb was studied above Debye temperature. The main assumptions of the Mott model were used. On the basis of published data on state density for 4d-transient metals, the temperature dependence on electric and thermal conductivity was calculated for effective density of states. Experimental data on Nb thermal conductivity are presented and the values of Nb specific electric resistance taking into account the thermal expansion of the sample are given. (FR)

**12631** THERMODYNAMIC PROPERTIES OF METALS AND CERAMICS AT ELEVATED TEMPERATURES. Hoch, M. (Cincinnati Univ., Ohio (USA). Dept. of Materials Science and Metallurgical Engineering). Rev. Int. Hautes Temp. Refract.; 12: No. 1, 8-11(Jan 1975).

From 4th European conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

The deviation at elevated temperatures of the specific heat from 3R in both solids and liquids is accounted for by an electronic contribution and an anharmonic term. In solids, the anharmonic term is proportional to $T^3$ and increases with temperature. In liquids, the anharmonic term rapidly decreases with increasing temperature. The data are not accurate enough to obtain concentration and energies of formation of vacancies from specific heat data. (FR)

**12632** ELASTIC NEUTRON AND THERMAL DIFFUSE X-RAY SCATTERING IN THE HIGH TEMPERATURE REGION OF SODIUM. Adlhart, W.; Pfeiffer, H.; Fritsch, G.; Luescher, E. (Technische Univ. Muenchen, Garching (F. R. Germany). Physik-Dept.). Rev. Int. Hautes Temp. Refract.; 12: No. 1, 48-51(Jan 1975).

From 4th European conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

Results on elastic neutron scattering around the [200] Bragg peak and on thermal diffuse x-ray scattering around the [110] reciprocal lattice vector of sodium are reported. The data are discussed in terms of the defect structure and a possible lattice instability at the melting point. In addition some remarks are made concerning the special nature of the melting transition. (FR)

**12633** PERTURBED ANGULAR CORRELATIONS WITH $^{111}$Cd IN THE $\alpha$ AND DELTA PHASES OF In-Sn. Budtz-Joergensen, C.; Bonde Nielsen, K. (Aarhus Univ., Denmark). Hyperfine Interact.; 1: No. 2, 81-92(Aug 1975).

The influence on the TDPAC distribution of dissolved impurities (Sn in In) and (In in Sn) as a function of concentration has been studied at room temperature and at liquid-nitrogen temperature. Models for the observed distributions of the electric field gradients are discussed. The results are consistent with theoretical

estimates of the screening charge distribution around the valency impurity. (auth)

**12634** SURFACE DIFFUSION OF MOLYBDENUM ATOMS ON TUNGSTEN SURFACES. Sakata, T.; Nakamura, S. (Osaka Univ., Suita (Japan). Inst. of Scientific and Industrial Research). Surf. Sci.; 51: No. 1, 313-317(Jul 1975).

To explore more fully the diffusion dynamics, quantitative measurements on the diffusion of molybdenum pairs on (211) planes of tungsten, compared to that of single isolated adatoms on the same planes were carried out; on the (321) planes of tungsten, the diffusion behaviour of single adatoms of molybdenum was also observed quantitatively. (auth)

**12635** TEMPERATURE AND PRESSURE DEPENDENCE OF THE ELECTRIC FIELD GRADIENT AT TANTALUM IN RHENIUM. Butz, T.; Potzel, W. (Technische Univ., Munich). Hyperfine Interact.; 1: No. 2, 157-166(Aug 1975).

The quadrupole interaction (QI) at substitutional Ta atoms in a Re matrix has been investigated by TDPAC between 1.2 K and 450°K. It was found to depend only weakly on temperature with a minimum around 200°K. No change in the QI was observed when the sample was cooled into the superconducting state. The QI was found to increase with pressure with the coefficient $(\partial \ln q/\partial P)_T = +0.93(23)10^{-3}$ kbar$^{-1}$ at 300 K. A discussion of the temperature and pressure variations in connection with published Mössbauer data reveals the role of the conduction electron contribution to the electric field gradient. (auth)

**12636** X-RAY EXAMINATION OF THE EFFECT OF $\alpha$-PHASE DEFORMATION TEMPERATURE ON THE TEXTURE OF QUENCHED URANIUM RODS HAVING VARIOUS IRON AND SILICON CONTENTS. Zelenski, V. F.; Kunchenko, V. V.; Krasnorutskii, V. S.; Roenko, N. M.; Ashikhmin, V. P.; Azarenko, A. V.; Stukalov, A. I. At. Energ. (USSR); 39: No. 1, 24-27(Jul 1975). (In Russian).

The results obtained in an experimental study of $\beta$-quenched uranium texture as a function of the preceding $\alpha$-phase deformation temperature are presented. Iron additions promote the formation of [010]-type texture. Silicon additions compensate the iron effect and promote [100]-type texture growth, other conditions of transverse $\beta$-quenching being equal. Possible mechanisms for the effect of iron and silicon additions on the $\beta$-quenched uranium texture are proposed. 4 figures, 15 references. (auth)

**12637** MAGNETIC SUSCEPTIBILITY OF DILUTE (La-Ce)$Al_2$ ALLOYS. Borchi, E.; De Gennaro, S. (Florence Univ. (Italy). Istituto di Fisica). Phys. Lett., A; 54: No. 2, 159-160(25 Aug 1975).

The magnetic susceptibility of dilute (La-Ce)$Al_2$ alloys is examined. A comparison between the experimental data and the theoretical calculations is carried out taking into account the influence of the crystal-field and the Kondo effect. (NL)

**12638** MICROWAVE DETECTION OF MAGNETIC EXCITATION IN THE HELICAL AND FAN PHASES OF $Gd_{0.61}Y_{0.39}$ CRYSTAL. Mojumder, M. A. (Institut d'Etudes Nucleaires, Algiers (Algeria)). Phys. Lett., A; 54: No. 2, 164-166(25 Aug 1975).

The calculations of magnetic excitation in the planar helical and fan phases of rare earths done by Cooper and Elliot have been extended, by including magnetoelasticity. Two of these excitations have been detected experimentally by microwave absorption technique. (NL)

**12639** REVIEW OF THE DEFORMATION BEHAVIOR OF TUNGSTEN AT TEMPERATURES < 0.2 OF THE MELTING POINT /K/. Stephens, J. R. (Lewis Research Center, Cleveland). Rev. Deform. Behav. Mater.; 1: No. 1, 31-70(1974).

The deformation behavior of tungsten at temperatures below 0.2 times the absolute melting temperature is reviewed with primary emphasis on the temperature dependence of the yield stress and the ductile-brittle transition. It is concluded that a model based on the high Peierls stress of tungsten best accounts for the observed mechanical behavior at low temperatures. Results of research suggest an important role of electron concentration and bonding on the mechanical behavior of tungsten. Future research on tungsten should include studies to define more clearly the correlation between electron concentration and mechanical behavior of alloys of tungsten and other transition metal alloys. (IAA)

**12640** MECHANISM OF EUTECTIC CRYSTALLIZATION. Fomichev, O. I.; Elina, E. V. Metall. Gornorudn. Prom-st.; 6: 29-31(1974). (In Russian).

The mechanisms underlying the formation of eutectic structures in the Cd–Sn and Cd–Bi systems are discussed in the light of recent investigations and existing data relating to the corresponding phase diagrams. Microanalysis confirms that the onset of eutectic crystallization does not always follow the simple pattern set out in elementary descriptions of eutectic processes. In the Cd–Bi system, even considerable supercoolings of a melt of eutectic composition does not lead to the formation of eutectic structures. In both systems eutectic crystallization begins after contact has been established between the two phases concerned. The ranges of combined growth are symmetrical and are displaced in the direction of the phases having the greater stability of their growth form. (Metals Abstr.)

**12641** NATURE OF SECONDARY HARDNESS IN MEDIUM-ALLOY HYPEREUTECTOID STEELS. Porada, I. L.; Ol'shanetskii, V. E.; Natapov, B. S. Metall. Gornorudn. Prom-st.; 6: 33-34(1974). (In Russian).

The secondary hardening of a number of medium-alloy hypereutectoid steels was studied. The principal factor, determining the effect of secondary hardening in these materials, was the presence of a large number of highly dispersed carbides, resistant to coalescence at high aging temperature and under service conditions. The presence and nature of these carbides were established by electron diffraction, for example, in ShKh15SGMF steel, aged at 400–500°C, carbides of the $Me_7C_3$(Me = Cr, etc.) and $Mo_2C$ appeared; in ShKh15SGM2V3F steel aged at 400–500°C the presence of VC, $W_2C$, and $Mo_2C$ was identified. (Metals Abstr.)

**12642** DIFFUSION BEHAVIOR OF TUNGSTEN CLUSTERS ON THE TUNGSTEN (110) PLANES. Cowan, P.; Tsong, T. T. (Pennsylvania State Univ., University Park). Phys. Lett., 53A: No. 5, 383-384(14 Jul 1975).

Diffusion of tungsten diatomic clusters on the W (110) exhibits comparable prefactor ($1.6 \times 10^{-4}$ cm$^2$/s) as single W atoms, but with slightly higher activation energy. Clusters with three atoms are unstable with respect to diffusion. (auth)

**12643** EXCESS ELECTRICAL CONDUCTIVITY IN THIN SUPERCONDUCTING LEAD FILMS ABOVE THE TRANSITION TEMPERATURE. Duggal, V. P.; Ashwini Kumar, P. K. (Univ., Delhi). Phys. Lett., 53A: No. 5, 397-398(14 Jul 1975).

Electrical conductivity measurements on thin superconducting lead films above the transition temperature are reported. It is observed that films grown at room temperature contribute to Maki–Thompson (MT) term whereas the ones grown at ~77°K don't. (auth)

**12644** INTERFERENCE PATTERNS IN THE CURRENT-VOLTAGE CHARACTERISTICS OF SUPERCONDUCTOR FILMS IN LONGITUDINAL MAGNETIC FIELD. Sugahara, M. (Yokohama National Univ., Japan). Phys. Lett., 53A: No. 5, 401-402 (14 Jul 1975).

Experimental evidence is presented showing that the induced voltage in the current-induced-transition region in dirty superconductor films in longitudinal magnetic fields reveals interference patterns as the applied current is changed. (auth)

**12645** REGULAR SOLUTIONS IN TITANIUM–VANADIUM PHASE EQUILIBRIA. Chernov, D. B.; Shinyaev, A. Ya. (Inst. of Metallurgy, Moscow). Russ. J. Phys. Chem. (Engl. Transl.); 49: No. 3, 445-446(Mar 1975).

Translated from Zh. Fiz. Khim.; 49: No. 3, 762-763(Mar 1975).

Discrepancies in the results obtained by different workers for the titanium-vanadium equilibrium diagram are due to impurities in the alloys used. The model of regular solutions is used to process the results of several workers and to refine the equilibrium diagram. (auth)

**12646** ELECTRONIC CHARGE DENSITY AT NUCLEAR SITES IN BERYLLIUM METAL: DEPENDENCE ON LATTICE CONSTANTS. Koiller, B.; Falicov, L. M. (Univ. of California, Berkeley). Phys. Rev.; 12B: No. 6, 2080-2083(15 Sep 1975).

A calculation of the electronic charge density at the nuclear site in beryllium metal as a function of lattice parameters is presented. It is based on an orthogonalized-plane-wave method and it includes changes in unit cell volume by -1 and -2 percent as well as changes in c/a ratio from the normal pressure value by +1 percent, 0 percent, and -1 percent. For a typical volume change of -2 percent, the conduction-electron charge density at the nuclear site changes by +1.4 percent. For the same volume change, the total electron charge density changes by +0.09 percent. (auth)

**12647** APW–LCAO BAND MODEL FOR A15 COMPOUNDS. Mattheiss, L. F. (Bell Telephone Labs., Inc., Murray Hill, NJ). Phys. Rev.; 12B: No. 6, 2161-2180(15 Sep 1975).

The results of nonrelativistic augmented-plane-wave (APW) band-structure calculations at symmetry points in the cubic Brillouin zone for $V_3Si$, $V_3Ge$, $Nb_3Al$, and $Nb_3Sn$ are fit using the Slater-Koster linear-combination-of-atomic-orbitals (LCAO) interpolation scheme. This LCAO model involves Bloch sums

formed from 30 A-atom (A equals V, Nb) d orbitals and eight B-atom (B equals Si, Ge, Al, Sn) s-p orbitals. In its simplest form, this LCAO model fits 73 APW energy eigenvalues at GAMMA, X, M, and R with an rms error of 0.020 to 0.023 Ry by means of 21 two-center parameters. Improved accuracy is achieved, particularly for states near E/sub F/, by weighting these more heavily in the LCAO fit, partially relaxing the two-center approximation, and increasing the number of LCAO parameters to 39. The results of this APW-LCAO model are applied to evaluate the accuracy of the Labbe-Friedel (LF) linear-chain and the Weger-Goldberg (WG) coupled-chain band models for the A15 compounds. It is concluded that (a) corrections to the LF and WG models (about 3 and 1 eV, respectively) are sufficient to wash out fine structure in the density of states on a meV energy scale; (b) there is no evidence for describing the electronic structure of these A15 as one-dimensional or quasi-one-dimensional in character; (c) the density-of-states peak near E/sub F/ involves primarily A-atom d states with $delta_1(x^2 - y^2)$ symmetry, in contrast to the predictions of the LF ($delta_1 + delta_2$) and WG ($delta_2$) models; (d) the accuracy of the present LCAO model is insufficient for predicting the precise shape of the density of states near E/sub F/ from first principles. (auth)

**12648** CRYSTAL EQUILIBRIUM AND PHONON DISPERSION IN SOME BCC TRANSITION METALS. Upadhyaya, J. C.; Sharma, S. S.; Kulshrestha, O. P. (Agra Coll., India). Phys. Rev.; 12B: No. 6, 2236-2242(15 Sep 1975).

A lattice-dynamical model has been developed for bcc metals which considers ion-ion interaction through second-neighbor central pair potential and electron-ion interaction based on the Sharma-Joshi theory. In the model the ionic lattice is in equilibrium in a medium of electrons. The theory has been applied to calculate the dispersion curves in a number of transition metals. The results when compared to experimental neutron data show a reasonably good agreement in the [100] and [111] directions, while sufficient deviations are present in the [100] direction. (auth)

**12649** ISOTOPE EFFECT FOR SELF-DIFFUSION IN Ge. Campbell, D. R. (Thomas J. Watson Research Center, Yorktown Heights, NY). Phys. Rev.; 12B: No. 6, 2318-2324(15 Sep 1975).

Although diffusion processes in elemental semiconductors have been extensively studied for nearly two decades, considerable controversy still exists over basic aspects of the diffusion process. In Ge, the vacancy mechanism is considered largely compatible with both experiment and theory but direct, experimental evidence indicating the single vacancy as the mechanism of self-diffusion at high temperature has not been previously offered. A radiotracer diffusion measurement can, in principle, identify the mechanism of self-diffusion via the isotope effect. This measurement was performed by simultaneously diffusing the isotopes $^{77}Ge$ and $^{71}Ge$ into single crystal, intrinsic Ge at temperatures of 900 and 925°C. In each of four runs the relative diffusivities of the two isotopes were measured from which four values of f DELTA K ranging from 0.25 to 0.31 could be determined. The results are consistent with a single vacancy mechanism for which the correlation factor f is 0.5, placing DELTA K in the range 0.5 to 0.6. (auth)

**12650** MECHANISMS OF FLUX LINE LATTICE MOTION IN A PEAK EFFECT SUPERCONDUCTOR. Lauterwasser, B. D.; Kramer, E. J. (Cornell Univ., Ithaca, NY). Phys. Lett., A; 53: No. 5, 410-412(14 Jul 1975).

The abrupt change in voltage-current characteristic of a Nb-10 at. percent Mo alloy observed as H is increased past a peak in the critical current implies a change in the mechanism of flux line lattice motion at the peak. (auth)

**12651** ANOMALOUS SHEAR ULTRASONIC ATTENUATION PEAK AT 95.5°K IN HOLMIUM. Lee, M. C.; Treder, R. A.; Levy, M. (Univ. of Wisconsin, Milwaukee). J. Phys. Chem. Solids; 36: No. 11, 1281-1286(Nov 1975).

An anomalous attenuation peak at 95.5°K has been observed for sheer ultrasonic waves transmitted along the c-axis of two holmium single crystals. The velocity change across this temperature is on the order of $10^{-4}$. In the presence of an external magnetic field, the peak moves toward high temperatures for both H||a and H||c. A rotation of the field in the basal plane produces a two-fold symmetry pattern in the attenuation. A double peak structure centered at the c-plane has also been observed when the field is rotated away from the a-axis. A considerable fraction of the attenuation peak appears to go as $\sin^2\theta$ where $\theta$ is the angle between the sheer wave polarization and the external field. (auth)

## Radiation Effects

*Refer also to abstracts 12668, 13459, and 13999.*

**12652** (BMI-1938) PROGRESS ON EVALUATING STRENGTH AND DUCTILITY OF IRRADIATED ZIRCALOY DURING JULY THROUGH SEPTEMBER 1975. Quarterly Progress Report on Task Agreement No. 61. Bauer, A. A.; Lowry, L. M.; Perrin, J. S. (Battelle Columbus Labs., Ohio (USA)). Sep 1975. Contract W-7405-eng-92. 34p. Dep. NTIS $4.00.

The characterization of fuel rods from the H. B. Robinson Power Plant was continued with the evaluation of gamma-scan, profilometry, plenum-gas, and burnup data. The rods exhibit varying degrees of ovality but no other clear evidence of cladding deformation. A good correlation exists between burnup and intensity of gross gamma activity. Isothermal and transient annealing studies have been completed on the cladding of Point Beach fuel rods. Hardness tests of isothermally annealed specimens are distinguished by the lack of time dependence evidenced in the hardness changes recorded. A pronounced dependence of hardness on heating rate and maximum temperature is observed for transient annealed specimens. Tensile test results indicate that recovery of strength properties precedes recovery of ductility both during low-temperature isothermal and during transient annealing treatments. Metallographic evidence shows that recrystallization of the cold-worked and irradiated Zircaloy cladding begins at some temperature between 1000 and 1150°F. (auth)

**12653** (CONF-751006-22) NATURE OF DEFECT CLUSTERS IN ELECTRON-IRRADIATED COPPER. Ohr, S. M. (Oak Ridge National Lab., Tenn. (USA)). 1975. 7p. Dep. NTIS $4.50.

From international conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

An electron microscope study has been made of the clustering of point defects in electron-irradiated copper in the range of temperatures between Stage III and Stage V. The samples used were single crystals of copper irradiated at 4°K with 3 MeV electrons to a dose of $1.4 \times 10^{19}$ electrons/cm$^2$. In all of the samples examined the defect clusters were in the form of dislocation loops, mostly less than 100 A in diameter. In samples warmed to room temperature, i.e. slightly above Stage III, the analysis of black-white contrast showed that the loops present were entirely of the interstitial type. In samples annealed at 90 and 150°C, the defects were predominantly loops of interstitial type, but approximately 10 percent of the loops were of vacancy type. At 250°C, the fraction of the loops of vacancy type increased to about 40 percent but the total loop density decreased markedly. The evidence seems to indicate that in Stage III vacancies do not cluster into sizes large enough to be visible in the electron microscope. (auth)

**12654** (GEAP-14062) SWELLING OF TYPES-304 AND -316 STAINLESS STEEL IRRADIATED TO $8 \times 10^{22}$ n/cm$^2$. Busboom, H. J.; McClellan, G. C.; Bell, W. L.; Appleby, W. K. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dep.). Jul 1975. Contract AT(04-3)-893. vp. AT.

Samples of Types-304 and -316 stainless steels covering a range of prior heat treatments and extent of cold working were irradiated in EBR-II to fluences of approximately $8 \times 10^{22}$ n/cm$^2$ at temperatures from 450 to 675°C. The results define the temperature dependence of swelling for these materials and show a temperature of irradiation for which swelling is a maximum. Cold working was found to be more effective in reducing swelling in Type-316 than in Type-304 stainless steel. The lowest maximum swelling was 0.5 percent DELTA V/V in 30 percent cold worked Type-316, compared to 2 percent DELTA V/V in the 20 percent cold worked condition and 4 percent DELTA V/V in the annealed material. Irradiation of prime specimens is being continued toward a fluence of $1.5 \times 10^{23}$ n/cm$^2$. Swelling of sodium-exposed materials on irradiation is also being studied. (auth)

**12655** (IS-M-49) INFLUENCE OF OXYGEN IMPURITY ATOMS ON DEFECT CLUSTERS AND RADIATION HARDENING IN NEUTRON-IRRADIATED VANADIUM. Bajaj, R.; Wechsler, M. S. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.; Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA)). 1975. 8p. (CONF-751006-19). Dep. NTIS $4.50.

From international conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

Single crystal TEM samples and polycrystalline tensile samples of vanadium containing 60-640 wt ppM oxygen were irradiated at about 100°C to about $1.3 \times 10^{19}$ neutrons/cm$^2$ (E greater than 1 MeV) and post-irradiation annealed up to 800°C. The defect cluster density increased and the average size decreased with increasing oxygen concentration. Higher oxygen concentrations caused the radiation hardening and radiation-anneal hardening to increase. The observations are consistent with the nucleation of defect clusters by small oxygen or oxygen-point defect complexes and the trapping of oxygen at defect clusters upon post-irradiation annealing. (auth)

**12656** (IS-M-50) RADIATION EMBRITTLEMENT OF METALS AND ALLOYS. Wechsler, M. S. (Ames Lab., Iowa (USA); Iowa State Univ. of Science and Technology, Ames (USA)). 1975. 19p. (CONF-751006-20). Dep. NTIS $4.50.

From international conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

Three types of radiation embrittlement are identified: (1) radiation embrittlement in nominally ductile metals, (2) radiation embrittlement in metals that undergo a ductile-brittle transition, and (3) high-temperature grain boundary embrittlement. This paper deals with type (1) and, more briefly, type (2) radiation embrittlement. Radiation embrittlement in nominally ductile metals is characterized by the premature onset of plastic instability, which causes a sharp decrease in the macroscopic plastic strain that the material can sustain before necking (uniform strain) and breaking (fracture strain). Dislocation channeling seems to be largely responsible and experimental results are reviewed. The origin of dislocation channeling is discussed. Irradiated metals that exhibit a ductile-brittle transition show an increase in the transition temperature but the nature of the transition (shear to cleavage fracture) does not appear to be greatly altered. A key factor is the temperature dependence of yielding and how it is affected upon irradiation. Impurities exert an influence on the stability of radiation-produced defect clusters and thus can alter the amount of radiation embrittlement experienced upon irradiation at somewhat elevated temperatures. In general, radiation embrittlement appears to stem mostly from changes in plastic properties (particularly in the trend toward more dynamic and inhomogeneous plastic deformation) rather than from changes in the inherent fracture process. 63 references, 10 figures. (auth)

**12657** INVESTIGATION OF RADIATION INDUCED DAMAGE BY CHANNELING IN Ni SINGLE CRYSTALS. Langguth, K. G. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). pp 239-249 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 May 1974).

The theory from Merkle et al. was applied to radiation damage in Ni single crystal caused by irradiation with 2 MeV $^4He^+$ ions. The determined dechanneling cross section $\sigma_d$ of the vacancy cluster in Ni was: $4 \times 10^{-15}$ cm$^2 \leq \sigma_d \leq 1.7 \times 10^{-14}$ cm$^2$ for 2 MeV $^4He^+$. These values are found within the limits of the dechanneling cross sections determined by Merkle for defect clusters in Au, which were between $4 \times 10^{-15}$ and $2.4 \times 10^{-14}$ cm$^2$ for the same particles and energies. The average cascade radius was found between 50 and 90A. (FR)

**12658** NEUTRON RADIATION EFFECTS ON BRITTLE FRACTURE PROPERTIES OF STEEL 15CH2MFA FOR REACTOR PRESSURE VESSELS. Haramia, F. (Vyskumny Ustav Zvaracsky, Bratislava (Czechoslovakia)). Zvaranie; 23: No. 12, 360-371(1974). (In Slovak).

Mechanical properties, such as the yield point in tension and tensile strength, notch impact and impact bending strength, were experimentally determined for steel 15CH2MFA irradiated with a fast neutron flux of 2.66 to $4.68 \times 10^{12}$ n.cm$^{-2}$.s$^{-1}$. The integral doses for individual samples corresponded to 0.85 to $1.66 \times 10^{19}$ n.cm$^{-2}$. The experiments were conducted in a temperature range of −160 to +250°C. (INIS)

**12659** GALVANOMAGNETIC MEASUREMENTS ON n- AND p-TYPE $\alpha$-TIN ELECTRON-IRRADIATED AT 5 K. Charles, J. E. (Queensland Univ., St. Lucia (Australia). Dept. of Physics); Myhra, S. (Griffith Univ., Nathan (Australia). School of Science). Phys. Lett., A; 54: No. 2, 140-142(25 Aug 1975).

Galvanomagnetic measurements were obtained for pure and doped n- and p-type $\alpha$-tin filaments irradiated by 1 MeV electrons at approximately 5°K. Variations in the Hall coefficient for highly degenerate samples were in qualitative agreement with theory. Carrier removal rates are reported; changes in these as a function of the initial position of the Fermi level indicate the presence of donor defect sites near $E_F = 0$ and acceptor defect sites deeper in the valence band. Isochronal annealing data have been obtained. (NL)

**12660** LUMINESCENCE OF METAL FILMS DURING THEIR SLOW-ELECTRON BOMBARDMENT. Borzyak, P. G.; Zavilopolu, A. M.; Kulyupin, Yu. A.; Konovalov, A. I.; Pilipchak, K. N.; Shpenik, O. B. (Uzhgorod State Univ., USSR). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 8, 730-731(1975). (In Ukrainian).

Luminescence of Au and Cu films was found in the visible region of the spectrum during their slow 5-200 eV electron bombardment. Spectral characteristics of the films emission are different for different metals and are the same in general for the continuous and discontinuous films of one and the same metal. (auth)

# Other Materials

*Refer also to abstracts 12085, 12599, 12622, 12683, 13059, and 13948.*

**12661** (CEA-N-1791, pp 44-45) STUDY OF THE DEFECTS CREATED BY ALKALI HALIDE BOMBARDMENT WITH HEAVY IONS. Delaunay, B.; Dupuy, C. H. S.; Guiraud, G.; Thevenard, P. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973−30 September 1974.

The $^{35}Cl$ beam of the tandem was utilized to study the color centers created in LiF and KCl crystals. The experiment is in good agreement with the Thevenard model predictions. (FR)

**12662** (JAERI-M-5998) ANALYTICAL STUDY OF MECHANICAL STRESSES OF GRAPHITE STRUCTURES WITH ATTENTION TO ANISOTROPIC PROPERTIES. Arai, T.; Satoh, S. (Japan Atomic Energy Research Inst., Tokyo). Feb 1975. 32p. (In Japanese). INIS.

Fuel elements for high-temperature gas-cooled reactors are mainly composed of graphite structurally, which has as-fabricated anisotropies; these increase with fast neutron irradiation. The relations have been studied between mechanical stresses introduced by reactor irradiation and anisotropies in Young's modulus, coefficient of thermal expansion, irradiation-induced dimensional change, and creep. The stresses in a hollow cylinder were analyzed both qualitatively and quantitatively on the basis of an anisotropic viscoelastic theory. The effects of anisotropies on thermal and irradiation stresses are appreciable in H-327 graphite of highest anisotropy, but insignificant in graphites of near-isotropy. The information obtained is useful for engineering stress analyses. (auth)

**12663** (SAND-75-8222) ABSORPTION INDUCED IN FIBER WAVEGUIDES BY LOW DOSE-RATE ELECTRON AND GAMMA-RAY RADIATION. Watkins, L. M. (Sandia Labs., Albuquerque, N. Mex. (USA)). Mar 1975. Contract AT(29-1)-789. 20p. Dep. NTIS $3.50.

Comprehensive measurements of absorption versus radiation dose and recovery versus time were performed in some optical fibers. Results show that the values of radiation-induced absorption are independent of dose rate from $5 \times 10^2$ to $6 \times 10^6$ rads/day for total doses to $6 \times 10^4$ rads. The fibers studied were Corning Low Loss, Schott UV, Crofon, Polystyrene Core, and Galileo K2-K irradiated with $^{60}Co$ gamma rays and $^{90}Sr$ beta particles. (auth)

**12664** EFFECT OF GAMMA RADIATION ON THE DISTRIBUTION OF SPECIFIC RESISTANCE IN EPITAXIAL LAYERS OF SILICON. Arifov, U. A.; Akurpekov, N.; Rainov, Yu. A.; Lyutovich, A. S.; Sribnaya, L. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 17-21(1975). (In Russian)

The effect of gamma radiation on the electrophysical properties of autoepitaxial layers of p-type silicon, prepared by hydrogen reduction of gaseous $SiCl_4$, on substrates of different specific resistances was studied. The electrophysical parameters were measured by the single probe method on oblique sections. The specific resistance of the film decreased, but with increasing dose it reached the initial value, while the specific resistance of the substrate increased to saturation when irradiated. (tr-auth)

**12665** EFFECT OF GAMMA RADIATION ON THE DISTRIBUTION OF SPECIFIC RESISTANCE IN THE DEPTH OF EPITAXIAL LAYERS OF SILICON ALLOYED WITH PHOSPHORUS. Akurpekov, N.; Belorusets, E. D.; Lyutovich, A. S. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 21-25(1975). (In Russian)

It was shown that irradiation of the subject material displaced the epilayer-substrate boundary toward the direction of the substrate. The specific resistance of the film started to decrease, but then increased with increasing dose and reached its initial value. The specific resistance of the substrate increased with dose to saturation. It is suggested that the results are due to diffusion of impurities and to radiation effects. (tr-auth)

**12666** ESR OF $CO_3^{3-}$−$Li^+$ CENTER IN AN IRRADIATED SYNTHETIC SINGLE CRYSTAL OF CALCITE. Bacquet, G.; Dugas, J.; Escribe, C.; Youdri, L. (Toulouse-3 Univ., 31 (France). Lab. de Physique des Solides); Belin, C. (Laboratoires d'Electronique et de Physique Appliquee (LEP), 94- Limeil-Brevannes (France)). J. Phys. (Paris); 36: No. 5, 427-429(May 1975).

An ESR spectrum of effective spin $S = \frac{1}{2}$ exhibiting a hyperfine structure quadruplet was observed in synthetic single crystal calcite x-irradiated at 20°C. From the g values it is deduced that this spectrum is due to a $CO_3^{3-}$ molecular ion, which is charge stabilized by an interstitial $Li^+$ ion. This defect which is axially symmetric along the crystalline c axis is very stable at room temperature. (FR)

**12667** CONDITIONS FOR A SPONTANEOUS BREAKDOWN OF THE SUPERCOOLING STATES OF HEAVY WATER. Lere-Porte, M. (Institut Universitaire de Recherche Scientifique, 64- Pau (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 16, 501-503(28 Apr 1975). (In French).

The study of heavy water, conducted on volumes between a few cubic centimeters and a few cubic microns, leads to same results as those found with similar volumes of natural water. The metastable behavior of heavy water under volumes between a few cubic centimeters and a few cubic microns is especially considered. (FR)

**12668** ION IMPLANTATION. Dearnaley, G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). pp 75-96 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 Mar 1974).

First, ion implantation in semiconductors is discussed: ion penetration, annealing of damage, gettering, ion implanted semiconductor devices, equipment requirements for ion implantation. The importance of channeling for ion implantation is studied. Then, some applications of ion implantation in metals are presented: study of the corrosion of metals and alloys; influence or ion implantation on the surface-friction and wear properties of metals; hyperfine interactions in implanted metals. (FR)

**12669** SPATIAL DISTRIBUTION AND ANNEALING OF DEFECTS RESULTING FROM BORON IMPLANTATION IN Si. Grob, J. J.; Siffert, P. (Centre National de la Recherche Scientifique, 67- Strasbourg (France). Centre de Recherches Nucleaires); Prisslinger, R.; Kalbitzer, S. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)); Linker, G.; Meyer, O. (Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Angewandte Kernphysik). pp 381-396 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French)

From meeting on particle channeling; Saclay, France (27 May 1974).

The defect distribution resulting from room temperature bombardment of silicon by low energy boron ions (8 to 100 keV) was investigated by backscattering of $^4He^+$ ions and channeling techniques. Contrary to the general accepted statement the profiles of the defects and of the boron ion are nearly identical. Annealed samples show a reverse annealing stage between 600 and 800°C, certainly related to the formation of rod like defects. (FR)

**12670** ROLE OF THE SO-CALLED COMMUNAL ENTROPY IN THE MELTING TRANSITION OF RARE GAS ELEMENTS AND METALS. Aston, J. G. (Oxford Univ. (UK). Dept. of Theoretical Chemistry; Pennsylvania State Univ., University Park (USA). Dept. of Chemistry). Rev. Int. Hautes Temp. Refract.; 12: No. 1, 64-66(Jan 1975).

From 4th European conference on thermophysical properties of solids at high temperatures; Orleans, France (4 Sep 1974).

It is shown that part of the melting transition is nonisothermal and that disordering prior to melting causes the transition to become isothermal. This disordering is solely responsible for an entropy change which has been called the communal entropy. (FR)

**12671** PREPARATION OF THICK TRITIUM (TiT) TARGETS ON Cu SUPPORT PLATES. Privarc, J. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav). Jad. Energ.; 20: No. 11, 378-379(Nov 1974). (In Czech)

A method for the production of thick tritium (TiT) targets on a Cu support is described. The Ti foil is soldered to the Cu support by means of an Ag layer. The production of supports for the targets and target impregnation with tritium is described. Neutron yields of several targets were investigated in dependence on the duration of irradiation. (auth)

**12672** MAGNETIC MEASUREMENTS ON BORIDES WITH $Fe_3C$-TYPE AND TAU-BORIDES. Sobczak, R. (Vienna Univ. (Austria). Inst. fuer Physikalische Chemie). Monatsh. Chem.; 105: No. 5, 1071-1076(Sep 1974). (In German)

Solid solutions $Co_{3-x}Fe_xB$ (x = 0–0.88), $(Ni,Co)_3B$, $(Ni,Fe)_3B$ having $Fe_3C$ type structure and $\tau$-borides of composition $Ir_{23-x}Fe_xB_6$ (x = 8–15) have been measured in the ferromagnetic and paramagnetic region in the range between 90 and 1270°K. (auth)

**12673** RADIOLYSIS IN NaCl AT ROOM TEMPERATURE. Corradi, G.; Voszka, R.; Gomaa, I. M. (Research Group for Crystal Physics, Budapest). Acta Phys. Acad. Sci. Hung.; 38: No. 3, 243-252(1975).

Optical absorption, ionic conductivity, thermoluminescence and roentgenoluminescence measurements on OH-free grown NaCl crystals both pure and doped with divalent cations were carried out in order to investigate the mechanisms of colour center production by x-irradiation at room temperature (RT). The coloration mechanism can be explained in terms of different possibilities of stabilization of interstitial Cl atoms produced by primary Frenkel pair production in the anion sublattice. Interstitial stabilization is found to be possible in vacancy pairs, in cation vacancies, and in the process of $V_3$ center production and interstitial aggregation near dislocations. On this basis a simple kinetic model is constructed that accounts for the observed concentration variations of the F-centres and other point defects and gives a correct value for the cation vacancy-divalent cation association energy. (auth)

**12674** CHANNELING EFFECT MEASUREMENTS OF THE RECRYSTALLIZATION OF AMORPHOUS Si LAYERS ON CRYSTAL Si. Csepregi, L.; Mayer, J. W. (California Inst. of Tech., Pasadena (USA)); Sigmon, T. W. (Hewlett-Packard Co., Palo Alto, Calif. (USA)). Phys. Lett., A; 54: No. 2, 157-158(25 Aug 1975).

The epitaxial regrowth from amorphous layers created by Si implantation into (100) and (110) Si was found to be linear with time with activation energy of 2.3 eV. At 550°C the growth rate on (100) Si is 80 Å/min. (NL)

**12675** EFFECT OF COLORED COMPONENTS ON RADIATION-OPTICAL STABILITY AND LIGHT PARAMETERS OF COLORED GLASSES. Kelina, R. P.; Troshin, V. V.; Glazkova, N. V. Zh. Prikl. Spektrosk.; 22: No. 6, 1071-1073(Jun 1975). (In Russian).

Results are presented of a study of the effect of the colored components CuO and $Cr_2O_3$ on the radiation-optical stability and the light properties of glasses. Glasses synthesized in a low-alkali system $SiO_2-K_2O-BaO-SrO-ZrO_2$ were selected for the study. The dependence of the light parameters and the radiation-optical stability of the glasses on the CuO content (0.5 to 2.5 wt %) and $Cr_2O_3$ (0.2–1.2 wt %) with $\gamma$ doses of $10^6$, $10^7$, and $10^8$ R was studied. The parameters used for determining the radiation-optical and illuminating properties of the glasses were the radiation-optical stability of the glass, increase in total optical density in the visible-spectrum region, light frequency (saturation), and light tone (wave length). The minimum CuO concentration that would form color centers was 1.5 wt %. The chromium-containing glasses were not very stable to $\gamma$ radiation. (tr-auth)

**12676** INFLUENCE OF IRRADIATION POWER DOSAGE UPON THE FATIGUE OF SELENIUM ELECTRORADIOGRAPHIC LAYERS. Varaneckas, J.; Montrimas, E.; Raksuskas, J. (Vilnyus State Univ.). Liet. Fiz. Rinkinys; 14: No. 5, 799-804(1974). (In Russian).

The fatigue process of the selenium electroradiographic layers under irradiation by x rays of a different power dosage was investigated. With increasing power dosage of irradiation the fatigue of the selenium layers may be considerably reduced at the power dosages less than about 50 to 100 R. The physical causes of the power dosage influence on the layer fatigue was elucidated and it is shown that these dependences are determined by the carrier lifetime at the traps responsible for the fatigue process. The fatigue dependence on the irradiation power dosage is strongly revealed for a relatively thin layer. This is caused by the variation of the parameters of the traps which takes place due to the thermal treatment during the layer evaporation. The thermal treatment leads to the reduction of carrier lifetime at the traps responsible for the fatigue process. (auth)

# NUCLEAR MATERIALS AND WASTE MANAGEMENT

**12677** (CONF-750827--, pp 383-402) WASTE MANAGEMENT AND SAFETY CONSIDERATIONS FOR FUTURE LASL D AND D PROJECTS. Valentine, A. M.; Warren, J. L. (Los Alamos Scientific Lab., NM). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

Currently excess contaminated facilities at the Los Alamos Scientific Laboratory are described along with associated Decontamination and Decommissioning waste management and safety considerations. Waste management and safety considerations are also briefly described for the removal and disposal of plutonium contaminated gloveboxes and equipment items in the LASL plutonium facility since the facility will be decontaminated when current operations are transferred to a new facility and for both past and future upgrading of the exhaust air filter system in a chemistry metallurgy research facility. (auth)

## Accountability and Safeguards

*Refer also to abstract 12091.*

**12678** (BARC-809) INDEPENDENT METHOD FOR INPUT ACCOUNTABILITY IN REPROCESSING PLANTS: MAGNESIUM TRACER TECHNIQUE FOR THE ACCOUNTABILITY OF PLUTONIUM (MAGTRAP). Mathews, C. K.; Jain, H. C.; Chitambar, S. A.; Kavimandan, V. D.; Aggarwal, S. K. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). 1975. 36p. Dep. NTIS (US Sales Only) $5.00.

A new technique for the measurement of the total plutonium in an accountability tank (MAGTRAP) is described which does not require a knowledge of either the total volume of solution in the tank or the size of the sample aliquot. The method depends on the addition of natural magnesium as a tracer and the subsequent isotope dilution of an aliquot using a spike with known $^{26}Mg/^{242}Pu$ ratio. Using only the isotopic ratios of $^{26}Mg/^{24}Mg$ and $^{239}Pu/^{242}Pu$ in the mixture, the quantity of the plutonium in the accountability tank can be calculated. In order to correct for magnesium blank, an additional measurement is required before tracer addition. The magnesium tracer technique can also be used to check the volume (or weight) calibration of the tank. An experiment was also conducted to measure the total uranium in the accountability tank using MAGTRAP. The accuracy was better than 1%. More experiments are planned. The tracer technique was also used to arrive at optimum sparging times to ensure the homogeneity of the solution in the tank. Chemical procedures developed for the separation of plutonium and magnesium from dissolver solutions are also discussed. (auth)

**12679** (SAND-75-6061) FIXED-SITE PHYSICAL PROTECTION SYSTEM MODELING. Chapman, L. D. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 15p. (CONF-751203-1). Dep. NTIS $4.50.

From winter computer simulation conference; Sacramento, California, USA (18 Dec 1975).

An evaluation of a fixed-site safeguard security system must consider the interrelationships of barriers, alarms, on-site and off-site guards, and their effectiveness against a forcible adversary attack whose intention is to create an act of sabotage or theft. A computer model has been developed at Sandia Laboratories for the evaluation of alternative fixed-site security systems. Tradeoffs involving on-site and off-site response forces and response times, perimeter alarm systems, barrier configurations, and varying levels of threat can be analyzed. The computer model provides a framework for performing inexpensive experiments on fixed-site security systems for testing alternative decisions, and for determining the relative cost effectiveness associated with these decision policies. (auth)

**12680** (SAND-75-6156) [SAFEGUARDS FOR THE PHYSICAL PROTECTION OF NUCLEAR MATERIALS AND FACILITIES]. Jones, O. E. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 10p. (CONF-751124-1). Dep. NTIS $4.00.

From assembly committee on resources, land use, and energy; Sacramento, California, USA (18 Nov 1975).

Testimony is given on the subject of safeguards for the physical protection of nuclear materials and facilities, particularly during transportation. The ERDA nation-wide safe-secure transportation system and the Safe-Secure Trailer are described. The nationwide ERDA voice communication system is also described. Development of hardware and systems is discussed. The use of adversary simulation for evaluating protection systems is mentioned. (DLC)

**12681** (SAND-75-6190) SECURITY FORCE-ADVERSARY ENGAGEMENT SIMULATION. Bennett, H. A. (Sandia Labs., Albuquerque, N. Mex. (USA)). 1975. 22p. (CONF-751203-2). Dep. NTIS $4.50.

From winter computer simulation conference; Sacramento, California, USA (18 Dec 1975).

A dynamic simulation of a security force-adversary engagement has been developed to obtain a better understanding of the complexities involved in security systems. Factors affecting engagement outcomes were identified and interrelated to represent an ambush of an escorted nuclear fuel truck convoy by an adversary group. Other forms of engagement such as assault and skirmish also can be simulated through suitable parameter changes. The dynamic model can provide a relative evaluation of changes in security force levels, equipment, training, and tactics. Continued application and subsequent refinements of the model are expected to augment the understanding of component interaction within a guard-based security system. (auth)

**12682** (SZS-165, pp 2-10) COMMENTS ON THE ORDINANCE CONCERNING THE CONTROL OF NUCLEAR MATERIAL. Gegusch, M.; Roehnsch, W. Aug 1974. (In German).

In report of the National Centre for Radiation Protection of the GDR. (Staatliches Amt fuer Atomsicherheit und Strahlenschutz, Berlin (German Democratic Republic)).

Starting from the development of international/safety aspects in using nuclear materials, the derivation of the Ordinance concerning the control of nuclear material from international agreements and existing national fundamentals is explained. The provisions contained in the Ordinance are commented on for the users of nuclear material in the GDR. Particularly the definition of nuclear material, introduction and limits of safeguards, possibilities of exemption from, and termination of safeguards are discussed. Furthermore, problems of transfer of nuclear material are dealt with, and the requirements for the institutional organization as a premise of an effective control are outlined. (INIS)

## Disposal and Storage

*Refer also to abstracts 11559, 11586, 11592, 11779, and 11791.*

**12683** (BNWL-SA-5581) EXPECTED BEHAVIOR OF HLW GLASS IN STORAGE. McElroy, J. L. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 27p. (CONF-751075-1). Dep. NTIS $5.00.

From CNEN seminar on HLW conversion to glass; Policoro, Italy (14 Oct 1975).

Glass produced by solidification of high-level radioactive liquid waste is studied. Conditions to which the waste form will be exposed in a typical handling sequence representative of current U. S. planning are tabulated. The reference matrix for waste form characterization is discussed, and some of the properties of high-level waste glass are described: physical properties, leachability, fracturing, vaporization, and containment in canister. 12 fig, 5 tables (DLC)

**12684** (CONF-750827--, pp 19-21) ERDA SAFETY PRACTICES INVOLVING DISPOSAL OF CONTAMINATED REAL PROPERTY. Loop, E. K. (Energy Research and Development Administration, Washington, DC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

A general discussion of the specific procedures for excess disposal outlined in the Property Management Handbook, ERDAM 5301 is given. (LK)

**12685** (CONF-750827-, pp 463-500) SUMMARY REPORT OF SOIL REMOVAL PRELIMINARY EXCAVATIONS. Wickland, C. E. (Rockwell International, Golden, CO). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research

and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

This report discusses a proposed technique to remove small areas, less than 2,000 $m^2$, of contaminated soil and the results of an actual excavation. Based on the results of a trial excavation in uncontaminated soil and an excavation of two trenches in contaminated soil, it is concluded that the techniques described are a satisfactory means of contaminated soil removal. It can be done safely with a release of airborne plutonium a factor of 10 or more below the Environmental Protection Administration (EPA) limit. (auth)

**12686** (CONF-750827-, pp 501-508) DISPOSAL OF PERSONAL PROPERTY FROM ERDA FACILITIES BEING DECOMMISSIONED. French, J. D. (Energy Research and Development Administration, Washington, DC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

Problem areas which should be considered early in planning the decommissioning of a facility are pointed out. (LK)

**12687** (INIS-mf-1771) NOTE ON STORAGE OF RADIOACTIVE WASTE IN DENMARK. (Danish Atomic Energy Commission, Risoe. Research Establishment). Nov 1974. 30p. (In Danish). INIS.

Published in connection with a report on present types of reactors for nuclear power stations, this note deals with radioactive waste disposal in general and in relation to possible future needs in Denmark in particular. Currently known Danish salt deposits seem unsuitable for storage of such wastes. Curves are given for relative toxicity, as ingested or inhaled, of fission products, lead, uranium ore, and the actinides plus radium. (INIS)

**12688** (ORNL-TM-4333(Pt.1)) ASSESSMENT OF THE LOSS OF RADIOACTIVE ISOTOPES FROM WASTE SOLIDS TO THE ENVIRONMENT. Part I. Background and Theory. Godbee, H. W.; Joy, D. S. (Oak Ridge National Lab., Tenn. (USA)). Feb. 1974. Contract W-7405-eng-26. 65p. Dep. NTIS $4.50.

A report is given of several theoretical expressions based on mass transport phenomena that relate the radioactivity escaping from such solids to diffusion, dissolution processes, surface conditions, and radioactive decay. Representative available data for radioactive waste solids incorporated in cement, asphalt, ceramic, and glass media are analyzed using the theoretical expressions presented. These analyses show that an expression taking into account diffusion and concentration-dependent dissolution gives good agreement with the data for most of the products considered. In the main, these products can be categorized as waste solids of low solubility incorporated in inert matrices. The effective diffusivities obtained are in the range of mid $10^{-17}$ to mid $10^{-12}$ $cm^2$/sec, the dissolution rate constants are in the range of high $10^{-9}$ to low $10^{-7}$ $sec^{-1}$, and the surface transfer constants are in the range of low $10^{-4}$ to low $10^{-3}$ $sec^{-1}$ for the products analyzed. Once determined, such parameters can be used to compare various waste products and to estimate releases from these products, in particular, long-term releases. (auth)

**12689** WASTE DISPOSAL ASPECTS OF THE LONG TERM COOLING CHARACTERISTICS OF IRRADIATED NUCLEAR FUELS. Clarke, R. H. (General Electricity Generating Board, Berkeley, Eng.); MacDonald, H. F.; Fitzpatrick, J.; Goddard, A. J. H. Ann. Nucl. Energy; 2: No. 6, 451-466(Jul 1975).

A study has been made of the long term cooling characteristics of nuclear fuels irradiated in commercial reactor designs of interest within the U. K. In the case of thermal reactors, Magnox, AGR, SGHWR, LWR and HTR systems fueled with either natural or enriched uranium are considered, together with a fast reactor fueled with plutonium derived either from the Magnox or the AGR programmes. Alternative uses for Magnox plutonium are considered by simulating a plutonium fueled HTR thermal system and the development of a $Th/^{233}U$ fuel cycle has been anticipated for both a fast reactor and an HTR. For each system the activities as a function of cooling time are considered on the assumption of U/Pu recovery from the fuel during reprocessing within a year of discharge from the reactor and for the alternative case of no U/Pu extraction. The reprocessing waste products associated with various fuel cycles have then been compared both on the basis of decay heating and radiological hazard per GW(e) yr. Finally, recycling of transplutonium elements is also considered with a view to reducing the long term heating commitment from the higher actinides. (auth)

**12690** WASTE MANAGEMENT. Soule, H. F. (Energy Research and Development Administration, Washington, DC). Health Phys.; 29: No. 4, 481-488(Oct 1975).

From plutonium: health implications for man. Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

Current planning for the management of radioactive wastes, with some emphasis on plutonium contaminated wastes, includes the provision of repositories from which the waste can be safely removed to permanent disposal. A number of possibilities for permanent disposal are under investigation with the most favorable, at the present time, apparently disposal in a stable geological formation. However, final choice cannot be made until all studies are completed and pilot phase demonstrates the adequacy of the chosen method. The radioactive wastes which result from all portions of the fuel cycle could comprise an important source of exposure to the public if permitted to do so. The objectives of the AEC waste management program are to provide methods of treating, handling and storing these wastes so that this exposure will not occur. Some of the problems and current progress of waste management programs are described with emphasis on plutonium-contaminated wastes. Since the technology in this field is advancing at a rapid pace, the descriptions given can be regarded only as a snapshot at one point in time. (auth)

## Handling Equipment and Procedures

**12691** (LA-3067-MS(Rev.)) LOS ALAMOS CRITICAL-MASS DATA. Paxton, H. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 57p. Dep. NTIS $5.50.

The original version of this report tabulates critical masses of simple systems, which have been measured through the year 1963. This revision adds data through October 1975, and modifies some of the old critical specifications that have been reevaluated. The old format and symbolism are retained to simplify reproduction.

**12692** (ORNL-TM-5113) COMPARISON OF HANSEN-ROACH AND ENDF/B-IV CROSS SECTIONS FOR $^{233}U$ CRITICALITY CALCULATIONS. McNeany, S. R.; Jenkins, J. D. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 21p. Dep. NTIS $5.00.

A comparison is made between criticality calculations performed using ENDF/B-IV cross sections and the 16-group Hansen-Roach library at ORNL. The area investigated is homogeneous systems of highly enriched $^{233}U$ in simple geometries. Calculations are compared with experimental data for a wide range of $H/^{233}U$ ratios. Results show that calculations of k/sub eff/ made with the Hansen-Roach cross sections agree within 1.5 percent for the experiments considered. Results using ENDF/B-IV cross sections were in good agreement for well-thermalized systems, but discrepancies up to 7 percent in k/sub eff/ were observed in fast and epithermal systems. (auth)

**12693** CONFINEMENT FACILITIES FOR HANDLING PLUTONIUM. Maraman, W. J.; McNeese, W. D.; Stafford, R. G. (Los Alamos Scientific Lab., NM). Health Phys.; 29: No. 4, 469-480(Oct 1975).

From plutonium: health implications for man. Proceedings of the second Los Alamos life sciences symposium; Los Alamos, NM, USA (22 May 1974).

Plutonium handling on a multigram scale began in 1944. Early criteria, equipment, and techniques for confining contamination have been superseded by more stringent criteria and vastly improved equipment and techniques for in-process contamination control, effluent air cleaning and treatment of liquid wastes. The evolution of equipment and practices to minimize exposure of workers and escape of contamination into work areas and into the environment is described. Early and current contamination controls are compared. (auth)

## Transportation

**12694** (DPSPU-75-124-1) SAFETY ANALYSIS REPORT: PACKAGES. Argonne National Laboratory SLSF Test Train Shipping Container, P-1 Shipment. Fissile Material. Final Report. Meyer, C. A. (Comp.). (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. (USA). Savannah River Lab). Jun 1975. Contract AT(07-2)-1. 61p. Dep. NTIS $4.50.

The package is used to ship an instrumented test fuel bundle (test train) containing fissile material. The package assembly is Argonne National Laboratory (ANL) Model R1010-0032. The shipment is fissile class III. The packaging consists of an outer

carbon steel container into which an inner container is placed; the inner container is separated from the outer container by urethane foam cushioning material. The test train is supported in the inner container by a series of transverse supports spaced along the length of the test train. Both the inner and outer containers are closed with bolted covers. The covers do not seal the containers in a leaktight manner. The gross weight of the shipment is about 8350 lb. The unirradiated fissile material content is less than 3 kg of $UO_2$ of up to 93.2 percent enrichment. This is a Type A quantity (transport group III and less than 3 curies) of radioactive material which does not require shielding, cooling or heating, or neutron absorption or moderation functions in its packaging. The maximum exterior dimensions of the container are 37 ft 11 in. long, $24^1/_2$ in. wide, and $19^3/_4$ in. high. (TFD)

**12695** (ORNL-TM-4905) SAFETY ANALYSIS REPORT FOR PACKAGING LAWRENCE LIVERMORE LABORATORIES SHIPPING CONTAINERS. Evans, J. H. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 191p. Dep. NTIS $7.60.

The Lawrence Livermore Laboratories shipping containers were designed at Oak Ridge National Laboratory for use in transporting weapons and nuclear components. The design for the containers was evaluated to show compliance with applicable regulations governing packages in which radioactive and fissile materials are transported. Computational procedures were used to determine the structural integrity and thermal behavior of the containers relative to the standards for the normal conditions of transport. A full-scale container test model was destructively tested to verify compliance with the standards for the accident conditions. The results of the analytical evaluations and the tests demonstrate that the design for the Lawrence Livermore Laboratories shipping containers is in compliance with the applicable regulations. (auth)

**12696** CONTAINERS FOR THE TRANSPORT OF RADIOACTIVE MATERIALS. (to NL Industries, Inc.). French Patent 2,215,675/A/. 30 Jan 1973. 14p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

The container consists of an internal envelope and an external envelope spaced from the internal one. There is a radiation shielding material in the space between the two envelopes. The internal envelope outlines a cavity in which the radioactive material is placed. The transverse section of the cavity is limited by three sides, each three sides joining the adjacent sides to define three vertices. The invention is applicable principally to the transport of spent fuel elements. (tr-FR)

**12697** CONTAINER AND VEHICLE FOR THE TRANSPORT OF RADIOACTIVE MATERIAL. Reese, S. L. French Patent 2,216,651/A/. 31 Jan 1973. 29p. (In French).

Available from Institut National de la Propriete Industrielle, Paris (France).

A receptacle and a vehicle for the transport of radioactive materials is described. The receptacle has smooth exterior walls on which immovable metal plates are fixed. The walls are of low density and good thermal conductivity with cooling fins. The container can be used for the transport of radioactive materials. (tr-FR)

**12698** PROBLEMS OF TRANSPORTING SPENT FUEL FROM POWER REACTORS. Arkhipovskii, Yu. I.; Burlakov, V. A.; Kondrat'ev, A. N.; Lyubimov, E. D.; Markovin, A. P. At. Energ. (USSR); 39: No. 1, 42-47(Jul 1975). (In Russian)

This article notes specific features of spent nuclear fuel as an object of transportation, presents characteristics of Soviet and DDR (Rainsberg Nuclear Power Station) spent fuel from a water-moderated water cooled reactor as a function of exposure time, and indicates requirements for shipping containers. Problems of biological shielding, heat removal and nuclear safety during transportation are discussed. Sketches of a special railcar, and inner and outer containers for transporting spent fuel from commercial reactor VVER-440 are presented. Features of certain Soviet and C.M.E.A. containers are compared with those of the General Electric JF-300 container. (auth)

# PARTICLE ACCELERATORS

## Design, Development, and Operation

*Refer also to abstracts 13015 and 13451.*

**12699** (AECL-5226) PHYSICS DIVISION PROGRESS REPORT, APRIL 1–JUNE 30, 1975. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1975. 135p. (PR-P-106). Dep. NTIS (US Sales Only) $7.00. AECL $3.00.

Operation of the MP tandem during the quarter is reviewed. Work is reported on the high-current test facility, electron test accelerator, fast intense neutron source, and heavy-ion superconducting cyclotron. Deorientation of aligned, energetic heavy ions was observed. Improvements in the QD$^3$ spectrometer were noted. Work in solid state physics included the study of the temperature dependence of positron annihilation in Cd. Research on detectors dealt with high-purity Ge crystals and CdTe crystals. Data analysis on tritium pickup was revised, and work on a gas dispersal system and the dynamic simulation of heavy-water plants continued. Research reports containing a significant amount of information are listed separately by title. (RWR)

*For titles of individual papers see: 12596, 12597, 13106, 13464, 13483, 13662–13664, and 13707.*

**12700** (BNL-20550(Vol.1), pp 170-181) NOVEL MECHANISMS FOR PARTICLE ACCELERATION. Willis, W. J. (European Organization for Nuclear Research, Geneva). 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summer reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

Intense relativistic electron beams (IREB) and lasers are considered as possible power sources for particle acceleration. IREB collective effect accelerators could lead to multi-GeV acceleration, but a method of controlling the velocity of the beam front, or charge neutralization, is needed. In principle, laser accelerators would work, but the maintenance of mechanical tolerances is difficult. Laser driven collective accelerators are also a possibility. (PMA)

**12701** (CEA-N-1791, pp 109-133) SACLAY LINAC OPERATION, MAINTENANCE, AND IMPROVEMENT. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

From October 1, 1973, to October 1, 1974, 3796 hours of beam time were available for physics experiments and accelerator studies. The lifetime of the klystrons and hard tubes was good. The main disturbances that appeared and the new elements introduced in order to improve the reliability in operation are discussed. The effects of high level radiation on the beam handling system are discussed (pion producing target, beam display systems, and NMR probes). Drastic improvement of the interlock system is envisaged by using a Merlin-Gerin PB6 programmable automatic device. (FR)

**12702** (CONF-741040--P1) PROCEEDINGS OF THE THIRD CONFERENCE ON APPLICATION OF SMALL ACCELERATORS, DENTON, TEXAS, OCTOBER 21–23, 1974. Volume I. The Use of Small Accelerators in Research and Teaching. Duggan, J. L.; Morgan, I. L. (eds.). (North Texas State Univ., Denton (USA)). 1974. 488p. Dep. NTIS $10.60.

Forty-seven papers were presented at the conference and are included in Volume I. A separate abstract was prepared for 46 papers for NSA. In addition, abstracts for 25 papers were prepared for ERDA Energy Research Abstracts (ERA). (RCK)

*For abstracts of individual papers see: 11425, 11469–11478, 11646, 11682–11688, 12084, 12703–12705, 12722, 12726, 12755–12757, 12903, 12904, 13003–13012, 13497, 13780–13782, and 13805.*

**12703** (CONF-741040-P1, pp 1-10) NEW HEAVY-ION ACCELERATOR FACILITY AT OAK RIDGE. Stelson, P. H. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In Proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Funds were obtained to establish a new national heavy-ion facility to be located at Oak Ridge. The principal component of this facility is a 25-MW tandem designed specifically for good heavy-ion acceleration, which will provide high quality beams of medium weight ions for nuclear research by itself. The tandem beams will also be injected into ORIC for additional energy gain, so that usable beams for nuclear physics research can be extended to about A equals 160. A notable feature of the tandem is that it will be of the "folded" type, in which both the negative and positive accelerating tubes are contained in the same column. The accelerator system, the experimental lay-out, and the time schedule for the project are discussed. (auth)

**12704** (CONF-741040-P1, pp 311-321) SURVEY OF TEACHING EXPERIMENTS WITH SMALL ACCELERATORS. Treado, P. A.; Lambert, J. M. (Georgetown Univ., Washington, DC). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Accelerator facilities are being used to provide an educational experience to undergraduate students, both science and non-science majors, and to graduate students. Nuclear physics, accelerator physics, atomic physics, chemistry, materials science, and some nuclear techniques applied to biology, medicine and energy/environmental problems are components of various courses. Previously published experiments are the ones most frequently used, but societal needs have caused some recent, interesting experiments to be adopted. A brief outline of a number of conventional and interesting experiments, and a tabulation of reference materials pertinent to such experiments is given. Experimental science can be presented to students in a dramatic and an exciting manner with an accelerator and readily available, but quite inexpensive, ancillary equipment. Lectures, discussions, demonstrations, and the collection and analysis of data provide a well-rounded educational experience. (auth)

**12705** (CONF-741040-P1, pp 371-373) INTERNATIONAL ATOMIC ENERGY AGENCY PROGRAMME AND ACTIVITY ON THE UTILIZATION OF LOW ENERGY ACCELERATORS. Shalnov, A. V.; Whetstone, S. L. (IAEA, Vienna). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

One of the chief missions of the Agency is as intermediary between the more highly developed of its member states and the less developed. This involves transmittal of needs of the latter to the former and, where possible, in response to the needs, an appropriate transfer of information and technical assistance. The physics section of the IAEA has recently encouraged and supported requests for technical assistance for programs based on neutron activation studies or pedagogic neutron physics experiments for institutes entering the nuclear field. Neutron generator laboratories have been set up with IAEA-assistance most recently in Burma, Hong Kong, Lebanon. Other recent technical assistance projects involving low-energy accelerators include: (1) consultation on the future program for the accelerator laboratory in Algeria; (2) equipment and experts to assist the nuclear physics program at the Van de Graaff in Bangladesh; (3) expert assistance and equipment in support of the installation of an electron linear accelerator in Egypt; and (4) expert assistance for nuclear physics studies at the cyclotron in Chile. A large number of young scientists, particularly from S.E. Europe, but also from the Middle East and South America, have received training in nuclear physics experimentation by advanced countries at low energy accelerator laboratories under the IAEA fellowship program. (auth)

**12706** (KURRI-TR-122, pp 52-54) PRESENT STATUS ON ULTRAHEAVY NUCLEUS SYNTHESIZING ACCELERATOR. Iwata, S. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

Among present heavy ion accelerators, the HILAC and the Cyclotron are the best for accelerating a variety of ions to high energies. A HILAC can accelerate heavy ions up to Argon to an energy of 10 MeV, and a cyclotron in Dubna, USSR, the largest scale accelerator, can accelerate heavy ions up to Krypton. However, an accelerating energy of 6 MeV/amu, the lowest energy to produce a nuclear reaction, can be obtained up to Zinc with the cyclotron. There are no reports of synthesis of ultra heavy nuclei with these cyclotrons, indicating that for ultraheavy nuclei

synthesis, heavy nuclei with A > 60 and with at least an energy of 6 MeV/amu are necessary. The SuperHILAC at Berkeley was constructed to produce accelerating energy of 8.5 MeV/amu. In West Germany, the Unilac, which will be able to accelerate heavy ions up to uranium to 10 MeV/amu, is under construction. Additional promising heavy ion accelerators are under development, including an electron ring accelerator, a charge change accelerator, and a superconducting linac. (JA)

**12707** (LA-6156-PR) MEDIUM-ENERGY PHYSICS PROGRAM. Progress Report, 1 May–31 July 1975. Dunn, E. (comp.). (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 65p. Dep. NTIS $5.45.

The continuing development, operation, and research programs of the LAMPF Linac (Clinton P. Anderson Meson Physics Facility) facilities are discussed. Progress on the following activities are reported: (1) engineering support; (2) accelerator support; (3) accelerator systems development; (4) injector systems; (5) electronic instrumentation and computer systems; (6) accelerator operations; (7) experimental areas; (8) large spectrometer systems; (9) research; (10) practical applications; (11) management; and (12) publications. (PMA)

**12708** (LA-UR-75-2205) CLINTON P. ANDERSON MESON PHYSICS FACILITY AND ITS OPERATIONAL SAFETY PROGRAM. Putnam, T. M. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 6p. (CONF-760202-17). Dep. NTIS $4.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

The Clinton P. Anderson Meson Physics Facility (LAMPF) at the Los Alamos Scientific Laboratory consists of/ (1) a medium-energy, high-intensity linear proton accelerator; (2) experimental areas designed to support a multidisciplined program of research and practical applications; and (3) support facilities for accelerator operations and the experimental program. The high-intensity primary and secondary beams at LAMPF and the varied research program create many interesting and challenging problems for the Health Physics staff. A brief overview of LAMPF is presented, and the Operational Safety Program is discussed, with emphasis on the radiological safety and health physics aspects. (auth)

**12709** (LA-UR-75-2235) AVERAGE NEUTRON ENERGY MEASUREMENT AT AN ACCELERATOR FACILITY, A PRACTICAL HEALTH PHYSICS PROBLEM. Miller, A. J. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 6p. (CONF-760202-12). Dep. NTIS $4.50.

From 9th topical symposium on operational health physics; Denver, Colorado, USA (9 Feb 1976).

Surveys designed to estimate the average energy of neutrons escaping from shielded enclosures were made at the Clinton P. Anderson Meson Physics Facility (LAMPF). Information obtained from these data proved to be of value in establishing response factors for the personnel monitoring dosimeters (NTA film). The value of measuring average neutron energies was demonstrated about one year ago, when the monthly film badge report indicated significant neutron exposures to personnel of an experimental group at LAMPF. Neutron radiation-survey data, as well as recorded data from area monitoring stations, indicated much lower personnel neutron doses. Subsequent average neutron energy measurements, at the location of interest, revealed a well-defined region where average neutron energies were considerably greater than previously measured in other occupied areas of the accelerator facility. A discussion is given the rationale for the decision to alter for these experimenters the NTA film response factors from that normally applied to the LAMPF film badges. (auth)

**12710** SPS IS NEARLY THERE. (CERN, Geneva). CERN Cour.; 12: No. 15, 386-389(Dec 1975).

The Super Proton Synchrotron (SPS) at CERN Laboratory II is nearing completion. The smaller proton synchrotron (PS or AG Synchrotron) is almost ready to fulfill its role as injector, and the necessary tunnels are complete. Electricity and cooling water supplies were established, and a magnet insulation problem was solved. Control computers were installed, and the associated electronics of the control system are being added. (PMA)

**12711** EXPERIMENTAL PROGRAM FOR THE SPS. Allaby, J. V. (CERN, Geneva). pp 604-633 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

A discussion is presented of experimental areas, instrumentation, and the planned activities at the CERN Laboratory II Super Proton Synchrotron (SPS). Future experiments will make use of a large hydrogen bubble chamber and a large magnetic spectrometer, and studies will be made on neutrinos, photons, hyperons, and hadrons. Several diagrams depicting the experimental facilities are given. (PMA)

**12712** PROTON SYNCHROTRON AT MEDIUM ENERGY. Basargin, J.; Komar, E.; Lobashev, V.; Shukejlo, J. Veda Tech. SSSR; 2: No. 5, 35-36(Oct 1974). (In Czech)

Translated from Doklady AN SSSR (1973) v. 209, no. 4.

Possibilities are discussed of obtaining 100-$\mu$A beams of 5 to 7 GeV protons. (INIS)

**12713** THREE-CENTIMETER MICROTRON HAVING A RATED ENERGY OF 4 MeV. Brezhnev, O. N.; Kazakevich, G. M.; Ponomarchuk, V. A.; Filippov, E. M. (Inst. of Geology and Geophysics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 338-340(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 17-19(1975).

A description and the characteristics are given for a 3 cm compact microtron rated at an energy of approximately 4 MeV The microtron was tested as a bremsstrahlung source for operation with an internal target and ensures a bremsstrahlung dose of at least 2 R/min · m. (auth)

## Auxiliaries and Components

*Refer also to abstracts 11778, 11903, 12081, and 12153.*

**12714** (INS-J-154) MAGNETIC FIELD MEASUREMENTS FOR THE INS SF CYCLOTRON. Tanabe, T.; Ogawa, H.; Sakurada, Y. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). 13 Oct 1975. 80p. Dep. NTIS (US Sales Only) $5.00.

The magnetic field of the INS SF cyclotron was measured with an accuracy of $1 \times 10^{-4}$. The field excitations, the field shape, the spiral angle, and the flutter are consistent with those expected from fields of a 1/1.645 model magnet. The amplitude of the first harmonic component is sufficiently well suppressed to maintain radial stability for all particles. (auth)

**12715** (ORNL-tr-4065) GENERAL STUDY OF TRIM COILS OF MAGNETS IN GANIL SECTORS. Riche, J. 3 Oct 1975. Translated by Martha Gerrard from GANIL 75-41. 21p. Dep. NTIS $4.50.

To obtain isochronism in the machine, an attempt was made to follow a B(r) law given by superposing on the basic field, in principle homogeneous, defined by the excitation coils and the poles, a corrector field formed by a system of correction coils arranged on the surface of the poles. The number of corrector conductors is limited by space considerations, cost, and the need to have separate feeds. (auth)

**12716** STABILIZATION OF PULSED-FIELD EMISSION. Anazawa, N.; Aihara, R.; Ohta, S. (Japan Electronic Optics Lab. Ltd., Tokyo). J. Phys., E (London); 8: No. 11, 971-976 (Nov 1975).

The effects of the background vacuum level and of atomic migration on the stability of pulsed-field emission were investigated. Initial studies concerned the emission characteristics that depend on the emitter temperature. Then the effects of the bias field and the change of the emitter shape were considered, in order to clarify the optimum condition for long-term stability. Conclusions are: (1) the characteristics of atom migration on the hot cathode surface agreed well with the Dyke theory; (2) the blunting of the emitter was successfully suppressed by applying an inverse bias field; (3) long-term stability of emission was obtained under the condition $F_a = (4/9)^4 F_{01}$; and (4) the emitter lifetime was not affected by the purity of the emitter material when the emitter radius was larger than 0.1 $\mu$m and the peak current density was less than $1 \times 10^{10}$ A cm$^{-2}$. (auth)

**12717** MONITORING OF THE SPATIAL POSITION AND PROFILE OF A PARTICLE BEAM. Amroyan, K. A.; Avakyan, K. M.; Aivazyan, R. B.; Matevosyan, E. M. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 362-364(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 35-37(1975).

A device is described which allows the spatial position and profile of a particle beam to be monitored within 0.65 mm during accelerator experiments. The device consists of a wire spark chamber with magnetostrictive acquistion of information and a video-monitoring device with a cathode-ray tube. (auth)

**12718** BETATRON ELECTROMAGNET WITH AZIMUTHAL VARIATION OF THE CONTROLLING FIELD. Zvontsov, A. A.; Chakhlov, V. L.; Filimonov, A. A. (Scientific-Research Inst. of Nuclear Physics, Electronics, and Automation, Tomsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 368-370 (1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 40-42(1975).

The construction of an electromagnet creating a control field with azimuthal variation in the pole gap of a betatron is described. Results obtained in the initial operation of a betatron with a control field of this kind are presented. (auth)

**12719** MAGNETIC COLLOID FOR ALIGNMENT WORK. Matveeva, E. N.; Pisareva, M. G. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 371-372(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 42-43(1975).

The technology of fabricating a magnetic colloid for use in alignment work in extracting channels of secondary particles from accelerators is presented. (auth)

**12720** NONDESTRUCTIVE MONITORING OF THE STATE AND CHARACTERISTICS OF TRITIUM TARGETS. Vorotnikov, P. E. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 373-375(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 43-45(1975).

A method is described for measuring the distribution of tritium in targets based on the use of kinematic peculiarities of the T (p,n)$^3$He reaction. (auth)

**12721** SIMPLE SPARK GAP FOR HIGH-VOLTAGE PULSE GENERATORS. Usov, Yu. P.; Tsvetkov, V. I.; Shatanov, A. A. (Scientific-Research Inst. of Nuclear Physics, Electronics, and Automation, Tomsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 461-462(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 112-113(1975).

A simple design is described for a high-voltage spark gap. The inductance of the spark gap is $5 \times 10^{-9}$ H. Tests were carried out at a voltage of 60 to 100 kV at currents of up to 20 kA. (auth)

# Ion Sources and Injection and Extraction Systems

**12722** (CONF-741040-P1, pp 11-30) ION SOURCES FOR ACCELERATORS. Alton, G. D. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

A limited review of low charge state positive and negative ion sources suitable for accelerator use is given. A brief discussion is also given of the concepts underlying the formation and extraction of ion beams. Particular emphasis is placed on the technology of ion sources which use solid elemental or molecular compounds to produce vapor for the ionization process. (auth)

**12723** (JINR-P9-9139) SYSTEM FOR CAPTURING INJECTED ELECTRONS WITHOUT ENERGY CHANGE. Gabanets, I.; Gurach, Kh.; Zhabitskii, V. M.; Ivanov, I. N.; Mironov, V. I.; Rashevskii, V. P.; Sergeev, A. P.; Stetsenko, S. G.; Tyutyunnikov, S. I.; Fartushnyi, V. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 20p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

An injection system was examined in which the magnetic field, rapidly changing at the moment of injection, is created by two pairs of coils with currents in opposite directions. The average field in such a system is significantly less than the field on the orbit, and, therefore, in the injection process, the energy of the electrons is practically unchanged. The dimensions of the beam are determined by the amplitude oscillations of the latest captured particles, which makes the system preferable for the injection of dense short bunches. (JSR)

**12724** DUOPLASMATRON HAVING A COLD CATHODE FOR AN INJECTOR IN A LINEAR PROTON ACCELERATOR. Batalin, V. A.; Kolomiets, A. A.; Kondrat'ev, V. K.; Kuibida, R. P. (Inst. of Theoretical and Experimental Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 344-345(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 21-23(1975).

A duoplasmatron having a cold cathode and a controllable intermediate-electrode potential is described. The source has a high reliability, ensures prolonged continuous accelerator operation, and allows smooth variation of the ion-current pulse length and control of the pulse length remotely from the accelerator control panel. (auth)

**12725** CHARACTERISTICS OF AN INJECTOR WITH AN EXPLOSIVE CATHODE. Chakhlov, V. L.; Pushin, V. S.; Vavilov, S. P. (Scientific-Research Inst. of Physics, Electronics, and Automation, Tomsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 346-348(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 23-25(1975).

The results of an experimental investigation of the output current and energy spectra of the electrons obtained from an injector with an explosive cathode used in a small betatron are presented. The electron energy is 200 keV, the injector current 1 kA, and the pulse length 2 nsec. (auth)

# Ion Optics and Field Calculations

**12726** (CONF-741040-P1, pp 43-57) ION OPTICS FOR ACCELERATORS. Enge, H. A. (Massachusetts Inst. of Tech., Cambridge). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

A review is given of ion-optic devices used in particle accelerators, including electrostatic lenses, magnetic quadrupoles, and deflecting magnets. Tube focusing in dc accelerators is also treated, and a novel scheme for shaping the electrodes to produce strong focusing is described. The concepts of emittance (phase space) and emittance conservation are briefly discussed. Chromatic and spatial aberrations are introduced, and it is shown how they can be calculated and sometimes substantially reduced. Some examples are given. (auth)

**12727** (JINR-R-9-8038) PRODUCTION OF RING ELECTRON BUNCHES. Stepanov, A. D.; Ivanov, G. A.; Golubev, I. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Dept. of New Acceleration Methods). 1974. 18p. (In Russian). INIS.

9 refs.; 5 figs.; submitted to Soviet Physics-Technical Physics.

A method is described for obtaining circular cross-section bunches in crossed fields of a magnetic type electron gun with cylindrical geometry. The electrical or magnetic field (or both) changes with time in the cathode region, and conditions are created for extraction of the electrons in drift space at definite time intervals. With a rate of change of electrical field of $2 \times 10^{11}$ V/cm.sec, a bunch of $2.5 \times 10^{-9}$ sec length was obtained with a longitudinal velocity in the cathode region of about $2 \times 10^7$ m/sec or less. In the drift region the longitudinal dimension of the bunch was contracted by a factor of 3 by using a "jump" in the magnetic field. (tr-auth)

**12728** ACCELERATION OF $^3$He IONS IN THE ISOCHRONOUS CYCLOTRON WITH REGULATED ENERGY OF THE IRF, KazSSR ACADEMY OF SCIENCES. Arzumanov, A. A.; Batishchev, V. N.; Kruglov, V. G.; Nigmatov, M. Kh.; Prokof'ev, S. I. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 73-75(1975). (In Russian)

Results are presented of work on formulation of regimes of accelerating doubly charged $^3$He ions in the isochronous cyclotron of the Institute of Nuclear Physics of the KazSSR Academy of Sciences. Helium-3 ions were accelerated in the energy range 18.6-61-8 MeV. The average (in time) beam current from the accelerator chamber falling on the remote target was 10 to 20 $\mu$A. (tr-auth)

**12729** CARDINAL ELEMENTS AND SPHERICAL ABERRATION OF MULTIELECTRODE TUBULAR SINGLE LENSES. Nurmanov, M. Sh. (Inst. of Nuclear Physics, Kazakh, USSR). Sov. Phys.–Tech. Phys. (Engl. Transl.); 20: No. 2, 155-158 (1975).

Translated from Zh. Tekh. Fiz.; 45: No. 2, 242-247(Feb 1975).

The positions of the cardinal elements and the spherical aberration are calculated for multielectrode, tubular, single electrostatic lenses. Calculations are carried out for 3, 5, 7, 15, and 31 electrodes, all with the same diameter, and for intermediate-electrode lengths of 0.5R and 2R. Lenses for which the ratio of potentials is constant or for which the difference between the potentials of adjacent electrodes is constant (in the first half of the lens) are treated. The potential in the second half of the lens is determined from field symmetry. (auth)

**12730** OBTAINING A SAWTOOTH BEAM CURRENT PULSE IN A HIGH-CURRENT ELECTRON GUN. Zakutin, V. V.; Nasonov, N. N.; Shenderovich, A. M. (Physicotechnical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 349-351(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 25-27(1975).

A current pulse was obtained with a long leading edge and a short trailing edge from a kiloampere beam in a direct-action electron accelerator. A smoothly rising beam current may be obtained by means of an appropriate selection of the anode–cathode gap and the cathode area. (auth)

**12731** GROWTH RATE OF THE POWER IN A PULSED HIGH-CURRENT BEAM OF ACCELERATED ELECTRONS. Slivkov, I. N. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 352-354(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 28-29(1975).

The growth rate of power of a beam of electrons obtained in pulsed high-current accelerators is limited by the wave impedance of the circuit sections, but primarily by the wave impedance of the diode. The indicated limitation may be overcome by means of a stepwise increase in voltage, and a method for effecting such an increase is proposed. (auth)

**12732** DEVICE FOR MEASUREMENT OF THE RADIAL-ANGULAR CHARACTERISTICS OF A HIGH-ENERGY ELECTRON BEAM. Artemov, V. I.; Lizunkov, V. I.; Peev, F. A. (Physico-technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 359-361(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 33-35(1975).

A device is described for measuring the profile and emittance of an accelerated electron beam having an energy of approximately 1 GeV and having transverse dimensions of 3 to 5 mm and a divergence $\sim 1 \times 10^{-4}$ rad. An ionization chamber having a high space resolving power (0.05 mm) was used as the beam detector. Block diagrams of the device are presented, along with examples of images of beam profile and emittance characteristics on the screen of an S1-42 oscilloscope. (auth)

**12733** OPTICA ELECTRONICA. (Electron Optics). Alexandru, G. Bucharest; Editura Academiei Republicii Socialiste Romania (1975). 268p.

A detailed description is given of the fundamentals of modern electron optics, including proofs for all basic formulas. Topics covered are: (1) formation of images using axially symmetric electric and magnetic fields; (2) fundamental relations of geometrical electron optics; (3) general properties of electron optical systems; (4) aberrations of axially symmetric electron optical systems; (5) multipole lenses; (6) static field mass separators; (7) mass spectrometers with parallel beams; (8) the cathode-ray tube optical system; (9) dynamic characteristics; and (10) electron optics and wave mechanics. (PMA)

## Storage Rings

*Refer also to abstract 11903.*

**12734** (BNL-20550(Vol.1)) PROCEEDINGS OF THE 1975 ISABELLE SUMMER STUDY, JULY 14-25, 1975. Volume I. Summary Reports of Working Groups. (Brookhaven National Lab., Upton, N.Y.(USA)). 1975. 195p. (CONF-750737-P1). Dep. NTIS $8.50.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

Results are presented of a project to improve, reinforce, or modify the concepts contained in the proposal for the ISABELLE storage rings. Summaries from the working groups are given, and the following topics are discussed: (1) initial and low-luminosity experiments; (2) design of a lepton detector; (3) large equipment and facilities; (4) experimental insertions; (5) new experimental ideas; (6) the accelerator lattice; (7) beam transfer, injection, and ejection; (8) beam stacking and acceleration; (9) performance limitations; (10) magnets and cryogenics; (11) radiation effects; (12) the vacuum system; (13) computer control and monitoring; (14) beam production options; and (15) novel acceleration schemes (for future accelerators). A separate abstract was prepared for each of the fifteen presentations for ERDA Energy Research Abstracts (ERA) and for Nuclear Science Abstracts (NSA). (PMA)

*For abstracts of individual sections see: 12700 and 12735–12748.*

**12735** (BNL-20550(Vol.1), pp 1-8) INITIAL AND LOW-LUMINOSITY EXPERIMENTS. Good, M. L. (State Univ. of New York, Stony Brook). 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

A study was made of possible experiments in hadron physics, and the results are summarized. All of the experiments examined were, as it turned out, capable of being performed on the planned ISABELLE storage rings without machine modifications. The areas of fundamental interest were: (1) total cross section studies; (2) multiplicity distributions and short range correlation studies; (3) elastic scattering; and (4) single particle spectra. (PMA)

**12736** (BNL-20550(Vol.1), pp 9-51) DESIGN OF A LEPTON DETECTOR FOR ISABELLE. Burnstein, R. (Illinois Inst. of Tech., Chicago); Carithers, W. C.; Duong-van, M. 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

The theoretical background is given for a proposed experiment to detect W mesons using their leptonic decay mode. A lepton detector was designed for use at the planned ISABELLE proton–proton colliding beam storage rings. The general configuration of the detector is shown, and an electron identification module, an electron-hadron calorimeter, methods of muon identification, and an optional central detector (magnetic solenoid spectrometer) are discussed. (PMA)

**12737** (BNL-20550(Vol.1), pp 52-69) LARGE EQUIPMENT AND FACILITIES. Rosenson, L. (Massachusetts Inst. of Tech., Cambridge); Ting, S.; Russell, J. 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

A general purpose modular multiparticle spectrometer for studying hadronic interactions was considered for the planned ISABELLE storage rings. Spectrometer systems considered had to meet several criteria, i.e., their net effect on the beams was to be made negligible; and their solid angle coverage, resolutions, and particle identification characteristics were to be optimized with respect to available space, machine constraints, and cost. The spectrometer configuration, associated detectors and their cost, magnets and their cost, vacuum chamber requirements, and the solenoidal magnet are discussed. (PMA)

**12738** (BNL-20550(Vol.1), pp 70-83) EXPERIMENTAL INSERTIONS. Sandweiss, J. (Yale Univ., New Haven; Kycia, T. F. 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

A discussion is given of the eight identical experimental insertions for the planned ISABELLE storage rings. Four sets of quadrupole doublets are used to match the beta functions in the insertions to the values in the cells, and the total free space available at the crossing point is 40 meters. An asymmetric beam energy operation is planned, which will be useful in a number of experiments. (PMA)

**12739** (BNL-20550(Vol.1), pp 84-110) NEW AND UNTHINKABLE IDEAS IN HIGH ENERGY PHYSICS. Lederman, L. M. (Columbia Univ., New York). 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

Possible future high energy physics experiments and the required detectors are discussed for colliding proton beams in storage rings. Analyses are given on the topics of: (1) baryon conservation; (2) a new object detector; (3) the search for heavy leptons at ISABELLE; (4) identifying super-massive particles decaying solely into very many hadrons; (5) production of antinuclei at ISABELLE; and (6) a metastable neutral particle arm. (PMA)

**12740** (BNL-20550(Vol.1), pp 111-116) ISABELLE LATTICE. Smith, L. (Univ. of California, Berkeley). 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

An analysis is given of a number of variants of the basic lattice of the planned ISABELLE storage rings. The variants were formed by removing cells from the normal part of the lattice and juggling the lengths of magnets, cells, and insertions in order to maintain a rational relation of circumference to that of the AGS and approximately the same dispersion. Special insertions, correction windings, and the working line with nonlinear resonances are discussed. (PMA)

**12741** (BNL-20550(Vol.1), pp 117-125) BEAM TRANSFER, INJECTION, AND EJECTION AT ISABELLE. Teng, L. C.

(Fermi National Accelerator Lab., Batavia, IL); van Steenbergen, A. 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

Although the design of the injection and the ejection-beaming dump systems for the planned ISABELLE storage rings is essentially complete, some efforts were made to review design details. The design was found to be sound and workable, and no obvious improvements were discovered. Several preliminary conclusions were drawn: (1) the impedance sum of the injection, ejection, and beam scraper components is expected to be less than 1 ohm; (2) all normal operation particle losses can be absorbed safely in the scraper-absorber systems as conceptually designed; (3) a fast accidental beam dump on the internal absorber at 30 GeV will not damage the absorber or drive the superconducting structure normal; and (4) a fast internal beam dump at 200 GeV would not drive the superconducting structure normal, but the beam absorber would suffer local damage. (PMA)

**12742** (BNL-20550(Vol.1), pp 126-132) STACKING AND ACCELERATION AT ISABELLE. Schnell, W. (European Organization for Nuclear Research, Geneva). 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

Beam transfer from the AGS and beam stacking in the planned ISABELLE storage rings are discussed, and a method for avoiding unnecessary dilution of the stacked beam is presented. Coupled longitudinal oscillations, instability inside a beam bunch at high inside-bunch mode numbers, and the possibility of rebunching and accelerating the stacked beam by a separate rf system are also discussed. (PMA)

**12743** (BNL-20550(Vol.1), pp 133-139) PERFORMANCE LIMITATIONS AT ISABELLE. Keil, E. (European Organization for Nuclear Research, Geneva). 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

The transverse stability of coasting beams in the planned ISABELLE storage rings was studied. The beam–beam tune shift limitation at 0.005 can be avoided, and a computer simulation seems to show 0.005 is a pessimistic limit. For beams of reasonable smoothness on the edge, the actual limit should be somewhat higher. Some coupling effects due to the beam–beam interaction are also examined. (PMA)

**12744** (BNL-20550(Vol.1), pp 140-148) MAGNET AND CRYOGENICS FOR ISABELLE. Thomas, D. B. (Rutherford High Energy Lab., Chilton, Eng.) 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

A critical review was made of the present status and future plans of the Brookhaven National Laboratory superconducting magnet program with respect to the planned ISABELLE storage rings. Recommendations are made on possible technical improvements, the future development program, and areas where cost reduction should be sought. (PMA)

**12745** (BNL-20550(Vol.1), pp 149-150) RADIATION EFFECTS AT ISABELLE. Sanger, P. A. (Fermi National Accelerator Lab., Batavia, IL); Danby, G. T. 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

Shielding, radiation damage, and radiation heating at the planned ISABELLE storage rings were considered. Radiation shielding studies were reviewed and were found to be adequate for present day dosage limits. Radiation damage could be encountered in some extreme cases, but is not expected to limit the performance of the superconducting magnets. Experiments to study the effect of radiation heating on actual magnets are recommended. (PMA)

**12746** (BNL-20550(Vol.1), pp 151-159) VACUUM SYSTEM FOR ISABELLE. Hobson, J. P. (National Research Council of Canada, Ottawa). 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

An analysis is presented of the proposed vacuum system for the planned ISABELLE storage rings with respect to acceptability and practicality from the vacuum viewport. A comparison is made between the proposed vacuum system and the vacuum system at the CERN ISR, and some comments on various design and operational parameters are made. (PMA)

**12747** (BNL-20550(Vol.1), pp 160-162) COMPUTER CONTROL AND MONITORING OF ISABELLE. Mallory, K. B. (Stanford Linear Accelerator Lab., CA). 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

The operational requirements of the computer control system for the planned ISABELLE storage rings are discussed. The system should consist of a large number of rather specialized computers, of one or at most two types, and should all use the same structure for programming, data management, and linking. (PMA)

**12748** (BNL-20550(Vol.1), pp 163-169) OPTIONS AT ISABELLE. Tigner, M. (Cornell Univ., Ithaca, NY). 1975.

From proceedings of the ISABELLE summer study; Upton, New York, USA (14 Jul 1975).

In proceedings of the 1975 ISABELLE summer study. Volume I. Summary reports of working groups. (Brookhaven National Lab., Upton, N. Y. (USA)).

The options available for producing proton-antiproton and proton-electron colliding beams at the planned ISABELLE storage rings were examined. A search was made for weak points in the options as proposed, and an effort was made to determine ways to improve the presently conceived designs. The methods proposed were found to be basically sound and can be expected to perform at levels given in the proposal. Some directions for further investigation are discussed involving phase space reduction of the beams, longitudinal polarization of electrons, and background problems. (PMA)

**12749** (RL-75-146(Add.)) ADDENDUM TO A PROPOSAL TO BUILD A 14-GeV ELECTRON–POSITRON COLLIDING BEAM FACILITY. (Science Research Council, Chilton (UK). Rutherford Lab.). Sep 1975. 80p.

A description is given of the current EPIC design for electron-positron operation, including improvements made to the original concept. The main ring was re-sited to encircle existing buildings, an improved method of filling positrons into the main ring was found, and it proved possible to improve the performance of the machine at higher energies without increasing the installed RF power. These various advances in design are summarized and are described in detail. (PMA)

## Experimental Facilities

*Refer also to abstracts 12127, 12128, 12146, 12711, and 12899.*

**12750** (CEA-N-1791, pp 56-61) ELECTRONICS. Afnaim, S.; Avril, M.; Branet, S.; Broutin, G.; Carnet, B.; Delaitre, B.; Gueguen, P.; Hameau, P.; Labrely, J.; Pages, A. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The two channel principle used in Saturne synchrotron systems for analog analysis is carried over the level of the charge preamplifiers. All digital electronic units are now designed according to the standard of blocks of words, composed of: (1) the instruction, (2) one or several whole words defining the parameters of the elementary information. (FR)

**12751** (CEA-N-1791, pp 163-164) TESTING THE SET-UP FOR PRODUCING MONOCHROMATIC PHOTONS IN THE HIGH ENERGY ROOM (HE3). Anderson, G.; Argan, P.; Audit, G.; de Botton, N.; Bloch, A.; Faure, J. L.; Laget, J. M.; Lopata, C.; Martin, J.; Schuhl, C. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The present status of the experimental set up for producing monochromatic photons in the energy range from 150 to 450 MeV is described. It has been tested with an electron beam, and neutron background is to be reduced using a Faraday cup made of nickel. (FR)

**12752** (CEA-N-1791, pp 165-167) PROJECT FOR A TAGGED PHOTON BEAM FROM IN-FLIGHT POSITRON ANNIHILATION INTENDED FOR TOTAL PHOTON ABSORPTION MEASUREMENTS. Martin, J.; Tamas, G. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A new beam handling system for positrons is studied in order to obtain a tagged annihilation photon beam. This beam will be used for total absorption experiments. (FR)

**12753** (CEA-N-1791, pp 167-170) DETECTION AND ACQUISITION SYSTEMS FOR THE 600 AND 900 MAGNETS. Lefebvre, M.; Lemarchand, G.; Millaud, J. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The acquisition system for both spectrometers "900" and "600" is described. Preliminary results are presented. (FR)

**12754** (CEA-N-1791, pp 170-172) DETECTOR SYSTEM OF THE 600 MAGNET. Cohen, L.; Dupont, J.; Grunberg, C.; Le Devehat, J.; Maurier, M. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Some views of the detector system which was built for the "600" spectrometer in the HE1 experimental room are presented and explained. (FR)

**12755** (CONF-741040-P1, pp 31-42) ACCELERATOR AND NEUTRON TARGETS: A SURVEY. Kobish, E. H. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Although advances in electronics, ion source physics, detector technology, and other technical aspects of accelerator science have resulted in the capability of making highly sophisticated and accurate measurements of nuclear and atomic properties, the significance of such measurements is frequently dictated by the form, composition, and other characteristics of the target containing the nuclear species being studied. Consideration must be given to the impurity content, number of isotope nuclei per unit area, uniformity of nuclei distribution in the target, physical strength of the target, and myriad other factors. Most target characteristics are related to the mode(s) of preparation and to the quality of isotopic material used. A wide variety of target types and associated preparative methods are described and evaluated, together with methods of target characterization. (auth)

**12756** (CONF-741040-P1, pp 58-63) RECENT TRENDS IN PARTICLE ACCELERATOR RADIATION SAFETY. Ohnesorge, W. F.; Butler, H. M. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

The use of particle accelerators in applied and research activities continues to expand, bringing new machines with higher energy and current capabilities which create radiation safety problems not commonly encountered before. An overview is given of these increased ionizing radiation hazards, along with a discussion of some of the new techniques required in evaluating and controlling them. A computer search of the literature provided a relatively comprehensive list of publications describing accelerator radiation safety problems and related subjects. (auth)

**12757** (CONF-741040-P1, pp 64-77) PRACTICAL AND RESEARCH ASPECTS OF BEAM-FOIL SPECTROSCOPY. Bashkin, S. (Univ. of Arizona, Tucson). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Practical aspects of the application of low-energy accelerators to research in beam-foil spectroscopy are discussed, and the kinds of equipment and associated costs are described in some detail. Some typical beam-foil experiments, emphasizing the most recent studies, are treated so as to show how relatively simple facilities can be used to produce physics of great interest. (auth)

**12758** MAGNETIC-INDUCTION METER FOR MEASURING THE AVERAGE CURRENT OF THE PROTON BEAM IN THE SYNCHROTRON OF THE INSTITUTE OF HIGH-ENERGY PHYSICS. Bolotin, I. M.; Kuz'min, A. A.; Shcherbakov, A. M.; Gertsev, K. F. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 355-358(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 30-33(1975).

A magnetic-induction meter for measuring the average current of a proton beam was developed for the Serpukhov accelerator and is described. The device allows measurement of either a bunched or debunched beam with an absolute error of ±0.32 mA ($10^{10}$ protons). The passband of the meter is 200 kHz. (auth)

**12759** EFFECT OF THE SLOPE OF THE FIELD BOUNDARIES OF AN ELECTROSTATIC ANALYZER ON ITS ION-OPTIC CHARACTERISTICS. Samsonov, G. A.; Sysoev, A. A.; Kuznetsov, V. N. (Engineering-Physics Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 376-378(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 46-47(1975).

The effect of the field boundary slope of an electrostatic analyzer on its ion-optic characteristics is investigated. In a practical analyzer, the length of the output arm, the energy dispersion, and the slope angle of the line of foci depend on the slope angle of the field boundary. Measured values are compared with the calculated values obtained both with and without allowance for the refraction of the ion trajectories by the boundaries of the electrostatic field. (auth)

**12760** COMMUTATION OF THE CAMAC SYSTEM USING TWO ELECTRONIC COMPUTERS. Mikhailov, Yu. V.; Shuvalov, R. S. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 424-426(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 83-85(1975).

Circuits are described which allow the CAMAC system to be used for operation with two electronic computers. The CAMAC is transmitted either by one of the two electronic computers, or else both electronic computers operate with the CAMAC system in a time-sharing regime. Such a joint operating regime allows maximum utilization of the capabilities of two electronic computers having different programming of software. However, if the data acquisition rate is restricted by the rate of rewriting information from the disk onto the magnetic tape in the intervals between accelerator pulses, then the utilization of the block allows doubling of the data acquisition rate in the experiment. The system was setup for the experiment performed on the 70-GeV accelerator of the Institute of High-Energy Physics involving the study of the $\pi^- p$ interaction with the formation of neutral particles in the final state where two computers—the IBM-1800 and TR-86—are used. (auth)

# PHYSICS (ASTROPHYSICS AND COSMOLOGY)

**12761** FOURIER ANALYSIS WITH UNEQUALLY-SPACED DATA. Deeming, T. J. (Texas Univ., Austin (USA)). Astrophys. Space Sci.; 36: No. 1, 137-158(Aug 1975).

The general problems of Fourier and spectral analysis are discussed. A discrete Fourier transform $F_N(\nu)$ of a function f(t) is presented which (i) is defined for arbitrary data spacing; (ii) is equal to the convolution of the true Fourier transform of f(t) with a spectral window. It is shown that the "pathology" of the data spacing, including aliasing and related effects, is all contained in the spectral window, and the properties of the spectral windows are examined for various kinds of data spacing. The results are applicable to power spectrum analysis of stochastic functions as well as to ordinary Fourier analysis of periodic or quasiperiodic functions. (auth)

**12762** SOME REMARKS ON ROCHE HARMONICS. Roach, G. F. (Goettingen Univ. (F. R. Germany)). Astrophys. Space Sci.; 36: No. 1, 159-167(Aug 1975).

Certain analytical aspects of the separability of the three-dimensional Laplace's equation in Roche harmonics are discussed. The intention is to provide a rigorous analytical basis of a further, more detailed investigation of the properties of Roche harmonics which will be developed more fully in subsequent communications. The arguments presented provide a generalization of some well known techniques in potential theory and as such can be shown to lead to a successively refinable approximation theory. (auth)

## Cosmic Radiation

*Refer also to abstracts 12886, 13122, 13126, and 13156.*

**12763** (INIS-mf-1805) SPATIAL AND SPECTRAL ANOMALIES IN THE SOFT X-RAY BACKGROUND. de Korte, P. A. J. (Rijksuniversiteit Leiden (Netherlands)). 1975. 96p. INIS.

See The Astrophysical Journal 190(1974)L5.

The results of two rocket-borne observations which were shown to be free of major ambiguities arising from UV-radiation and low-energy electrons are reported. Two different entrance windows were used, which provides the means to determine the spectral distribution of the cosmic soft X-ray background with a better energy resolution than attainable with the proportional counters themselves. X-ray sky maps covering about 50% of the total sky are presented, and from these it is seen that a large part of the soft X-ray background is probably of galactic origin, and that there are associations between certain X-ray features and the Cetus arc and Loop IV, and faint B$\alpha$-nebulosities. (NL)

**12764** (ISAS-507) MEASUREMENTS OF COSMIC-RAY IONIZATION FROM SEA-LEVEL TO 25 km ALTITUDE. Iida, T.; Ikebe, Y.; Nakashima, Y.; Kawano, M. (Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science). Mar 1974. 9p. INIS.

In each of the autumn of 1967, 1968, 1969, and 1970 four balloon flights were made at low latitudes, Taiyo (mag. lat. 26°N) and Haranomachi (mag. lat. 28°N) in Japan. Vertical profiles of the ionization intensity due to cosmic-rays were obtained with spherical chambers carried by balloons. The maximum ionization intensity was about 110J at an altitude of 17 km. The observed ionization intensities showed a decrease of about 10 percent as compared with that deduced from the data obtained by Neher in 1965. This seems to be ascribed to the 11 years solar-cycle. (auth)

**12765** (KURRI-TR-122, pp 18-19) MEASUREMENT OF HEAVY NUCLEI IN PRIMARY COSMIC RAY. Miyashima, M. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

The measurement of charge spectra of heavy charged particles in primary cosmic ray gives information concerning the synthesis of elements in the progress of stars. Elements with the atomic number Z of 26-83 are the information source for S-process. Knowledge on transbismuth elements gives information for $\gamma$-process. Existence of transuranium elements was predicted theoretically by Nielson, Nix and others. If they are detected in cosmic ray, new aspects concerning the synthesis of elements will be developed. The measurement of heavy particles with X-ray films on a balloon is proposed. The purpose of the measurement is to obtain detection efficiency if it is confirmed that Fe-group in relativistic domain is observable with X-ray films, to identify the velocity of particles by measuring the spatial distribution of blackness along flight track, to make test of a pin-hole detector, and to carry out test of the determination of nuclear charge in the range of relativistic velocity by measuring etching rate along the flight tracks of heavy ions. The measurement and analysis are in progress. (Kato, T.)

**12766** (NP-20750) EXCITATION FUNCTIONS FOR SOME NUCLEAR REACTIONS RELEVANT TO THE COSMIC RAY PROPAGATION PROBLEM. Raisbeck, G. M.; Yiou, F. (Centre National de la Recherche Scientifique, 91-Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse). 1975. 4p. Dep. NTIS (US Sales Only) $3.50.

Cross sections have been measured for the production of a number of radionuclides from targets of O, Mg, Si, Fe, and Ni irradiated by protons of 1, 2, 3, and 25 GeV. The results are discussed in connection with the "asymptotic" energy at which nuclear cross sections (and thus cosmic ray secondary production) can be assumed to become constant. This energy is seen to depend on the mass of the target and the product being considered. (auth)

**12767** COMPOSITION AND ENERGY SPECTRUM OF A PRIMARY COSMIC RADIATION OF MIXED ORIGIN. Sitte, K. (Univ., Freiburg i. B.). Nuovo Cim., A; 30A: No. 2, 195-211 (21 Nov 1975).

Consequences of a two-component theory of cosmic-ray origin are investigated in which composition and mixing ratio of the components conform to the suggestions of Reeves, and the sources — extragalactic for the larger, galactic SN for the smaller part — to those of Karakula et al. In any «mixed» model an extragalactic component must have traversed a larger amount of interstellar matter, passing through its source region and possibly other galaxies, than its galactic counterpart. To the latter a mean path length of $\approx 2$ g/cm$^2$ can be assigned, identical with that deduced for cosmic-ray electrons which are certainly of galactic origin. Arbitrarily choosing 7 g/cm$^2$ as the mean path length of extragalactic particles, the abundance ratios of the various groups of heavy nuclei are evaluated. The energy distributions at arrival of the heavy primaries, and from them the energy dependence of the abundance ratios L/M and M/Fe, are determined under the assumption that the experimental spectrum of Fe nuclei is characteristic for the SN-produced galactic particles, and the proton spectrum of Ryan et al. for the extragalactic component. The agreement with the experimental data is satisfactory. The absolute intensities calculated as a function of the energy indicate dominance of heavy primaries in the range of the «bulge» of the energy spectrum above $\approx 10^{13}$ eV. This may explain discrepant results between primary spectra deduced from data on atmospheric secondaries and spectra derived from the size distribution of EAS. (auth)

**12768** COSMIC-RAY ELECTRONS AND GALACTIC RADIO NOISE: SOME PROBLEMS. Gavazzi, G.; Sironi, G. (Univ., Milan). Riv. Nuovo Cim.; 5: No. 2, 155-186(1975).

An attempt is made to interpret first separately the electronic component of the cosmic rays and the galactic component of the celestial radio background, then the two pieces of information are examined together. (JFP)

**12769** X AND $\gamma$ DIFFUSE BACKGROUND. Horstman, H. M. (Univ., Bologna); Cavallo, G.; Moretti-Horstman, E. Riv. Nuovo Cim.; 5: No. 2, 255-311(1975).

Experimental results and theoretical interpretations of the electromagnetic diffuse background from 0.1 keV to 100 MeV are discussed. By diffuse background is meant the remaining radiation after the contribution due to discrete sources is subtracted and corrections are made for the internal background. The review is intended to be complete up to the end of 1973 but publications of 1974 are also included. The main concern was the definition of the intensity and coarse spectra of the diffuse background. (JFP)

**12770** INFORMATION FROM COSMIC RAYS ABOUT PARTICLE INTERACTIONS FROM $2 \times 10^3$ TO APPROXIMATELY $10^7$ GeV. Gaisser, T. K. (Bartol Research Foundation, Swarthmore, Pa. (USA)). pp 411-422 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

A brief survey is given of various types of cosmic ray experiment, the interaction energies probed by each and the limitations and problems of this approach to high energy physics. The goal

is to provide a realistic assessment of the kind of information one can hope to obtain now from cosmic ray data about properties of particle interactions beyond ISR energies. (FR)

**12771** ISOTOPIC ANALYSIS OF COSMIC RAYS BY THE CHERENKOV–CHERENKOV SLOWING-DOWN METHOD. Meyer, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Service d'Electronique Physique). ELDO/ESRO Sci. Tech. Rev.; 7: No. 1, 61-73(1975).

The performance of a large-scale Cherenkov–Cherenkov slowing-down set-up for isotope analysis in the 1-2 GeV/n region is analyzed. Such a set-up should permit isotopic analysis of all nuclei between neon and nickel with rms mass errors $<0.5$ amu and $<1$ amu over, respectively, approximately 250 MeV/n and approximately 500 MeV/n wide energy ranges. The background associated with the very high rate of nuclear interactions in the instrument (75%) should be eliminated by a triple redundancy in the charge measurement. These estimates are based largely on experience gained from Danish–French balloon flights and from runs at the Berkeley Bevatron. (FR)

**12772** THE ENERGY SPECTRUM OF COSMIC RAY ELECTRONS BETWEEN 10 AND 1000 GeV. Anand, K. C.; Daniel, R. R.; Stephens, S. A. (Tata Inst. of Fundamental Research, Bombay (India)). Astrophys. Space Sci.; 36: No. 1, 169-175 (Aug 1975).

Measurements made by the Bombay Group on the fluxes of cosmic ray electrons in the energy range 10-1000 GeV have been compared with those of other workers in the same energy domain with a view to understand the present confused situation on the existing observations at these high energies. Such an analysis clearly brings out the current situation in its true perspective and highlights the care and emphasis to be placed on future experimentation in this important field. (auth)

**12773** HADRONIC INTERACTIONS AND COSMIC RADIATION AT ENERGIES ABOVE $10^5$GeV. McCusker, C. B. A. (Sydney Univ. (Australia). School of Physics). Phys. Rep.; 20: No. 4, 229-285(Sep 1975).

90 refs.

A selection of results in particle physics is given from experiments with the cosmic radiation from about 1960 to December 1974. Mostly, the results are from interactions of energy greater than $10^5$GeV. The topics covered are: variation of charged particle multiplicity with energy, rise in the p-p cross section with energy, rise in the N-N production cross section with energy, the mean $p_t$ and its distribution at energies from $10^5$ to $10^8$GeV, the mass spectrum of "fireballs" and the transverse momenta of decay products in the fireball CMS, other emulsion chamber results including the event "Centauro", the search and evidence for very massive, comparatively stable particles, interactions between $10^{17}$ and $10^{12}$eV. (auth)

**12774** METAGALACTIC PROTONS OF ULTRA-HIGH ENERGIES. Berezinsky, V. S.; Grigor'eva, S. I.; Zatsepin, G. T. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij). Astrophys. Space Sci.; 36: No. 1, 17-30(Aug 1975).

The flux density of ultra-high-energy metagalactic protons generated by normal galaxies is calculated. Energetic losses of protons at interaction with the 2.7° relict and infrared radiations are revised. The time change of the energy of protons with different energies is estimated. The influence of fluctuations of energetic losses of protons on their spectrum is evaluated. The measured spectrum of cosmic rays can have a steepening ($\Delta\gamma \sim 1.6$) at $E \sim 3 \times 10^{19}$ eV instead of a sharp break expected previously. (auth)

**12775** SOME RECENT DEVELOPMENTS IN COSMIC RAYS. Hillas, A. M. (Leeds Univ. (UK). Dept. of Physics). Phys. Rep.; 20: No. 2, 59-136(Aug 1975).

297 refs.

Recent work on the energy spectrum, composition and anisotropy of the primary cosmic ray flux from about $10^9$ eV to $10^{20}$ eV is summarized, together with related information on photons between 1 MeV and 200 MeV. Solar particles are not discussed, the emphasis being on topics bearing on the origin of the radiation, which is still an unsolved problem, although the probabilities are strongly in favour of an entirely galactic origin for the particles. Mechanisms of acceleration are not discussed. (auth)

**12776** INVESTIGATION OF COSMIC RADIATION BY THE INTERKOSMOS 3 AND 5 SATELLITES. Fischer, S. (Ceskoslovenska Akademie Ved, Prague. Astronomicky Ustav). Vesmir; 53: No. 11, 330-333(1974). (In Czech)

The orbit parameters and the instrumentation are described of the Interkosmos 3 and the Interkosmos 5 satellites designed for direct charged particle detection in the near outer space. The experiments conducted by the satellites while in low orbits concentrated mainly on the dynamics of high energy charged particles in the inner layers of the magnetosphere at various levels of the solar activity and of geomagnetic disturbances. (auth)

**12777** ORIGIN OF THE BACKGROUND RADIATION. Dehnen, H. (Konstanz Univ. (F. R. Germany). Fachbereich Physik); Hoenl, H. (Freiburg Univ. (F. R. Germany). Fakultaet fuer Physik). Astrophys. Space Sci.; 36: No. 2, 473-478(Sep 1975).

From the assumption of a universal upper limit for the temperature of about $10^{12}$K, which is suggested by the experiences of high energy physics, it follows taking additionally into account the strong interaction between hadrons explicitly, that in the earliest stage of the Universe the numbers of photons and of nucleons-antinucleons should have been nearly equal, but greater than the present nucleon number by a factor of about $10^7$. Accordingly the 3K background radiation is generated for the most part by annihilation of nearly all primordial heavy particles. (NL)

**12778** ACCELERATION OF COSMIC RAYS. Sarris, E. T. (Iowa Univ., Iowa City (USA). Dept. of Physics and Astronomy). Astrophys. Space Sci.; 36: No. 2, 467-472(Sep 1975).

The intensive acceleration of energetic charged particles in perpendicular shock waves which has been known to take place in the interplanetary medium has been utilized in this work in order to account for the energization of cosmic rays. It is proposed that cosmic rays can be accelerated up to $10^{14}$-$10^{15}$eV in successive perpendicular shock waves which appear inside supernova shells in our Galaxy. (NL)

**12779** INTERRELATIONSHIP BETWEEN COSMIC DUST AND THE MICROWAVE BACKGROUND. Wesson, P. S. (Cambridge Univ. (UK). Inst. of Theoretical Astronomy). Astrophys. Space Sci.; 36: No. 2, 363-382(Sep 1975).

Attention is given to the radiation of microwaves by charged dust in space. Presently used particle distributions do not restrict the presence in space of large numbers of small ($r < 10^{-6}$ cm) silicate grains, but it is shown that such densities ($\rho$ approximately $10^{-25}$-$10^{-26}$ g cm$^{-3}$) of small grains would produce a microwave background with an energy density of the same order of magnitude as the energy density of the (presumed) cosmological 3 K background. Limits set by the isotropy of the latter are: $\rho$(H I clouds) $<$ or $\simeq$ to $10^{-26}$, $\rho$(galactic plane) $<$ or $\simeq$ to $10^{-30}$, $\rho$(Halo) $<$ or $\simeq$ to $10^{-32}$, $\rho$(Local Group) $<$ or $\simeq$ to $10^{-34}$ g cm$^{-3}$. These limits imply that either there is a cutoff in particle distributions at $r \simeq 10^{-6}$ cm, or that the density of silicate grains in space has been generally overestimated, or that cosmic rays have broken up a lot so that they now form a population of grains of very small size $\simeq 10^{-7}$ cm which are difficult to detect by conventional methods. (NL)

## Stars

*Refer also to abstracts 12795 and 13497.*

**12780** (KURRI-TR-122, pp 8-14) DYNAMICS OF EXPLOSION OF SUPERNOVA AND GAMMA PROCESS. Sato, K. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

The formation of superheavy nuclei at the time of the explosion of supernova was investigated. The evolution of stars is determined from the mass, angular momentum, and chemical composition at the birth of the stars. In case of the mass $M > 9\ M_\odot$, Fe core is formed at the center of stars, and this core disintegrates due to the increase of temperature and density of the stars. The atomic nuclei in the stars begin to transfer to neutron-rich nuclei by capturing degenerate electrons. Then, the energy emission of neutrino increases, and temperature rise is suppressed. Numerical experiment was carried out by considering the basic process of stars. The generation and propagation of shock waves were observed. This experiment may predict emitted mass, energy and the size of residual neutron stars. It is also possible to know the critical mass for becoming black holes. The mass of the stars which can explode as supernova is estimated to be $3-30\ M_\odot$. The synthesis of elements in supernova was calculated. The calculation was made in four steps of the process, such as the production of large amount of neutrons due to $\gamma$-process, the recombination of nucleons and the formation of nuclei owing to the temperature drop accompanying expansion, the progress of the $\gamma$-process, the transfer of nuclei toward $\beta$-stable line. The result of the calculation of each step is shown in a figure. (JA)

**12781** BLACK HOLES. Ruffini, R. (Inst. for Advanced Studies, Princeton, NJ). pp 888-914 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press

Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The discussion of black holes covers the basic theoretical works on gravitational collapse, the discovery of collapsed objects, and black holes and microphysics. (JFP)

**12782** TYPE I SUPERNOVAE AND ANGULAR ANISOTROPY OF THE HUBBLE CONSTANT. Le Denmat, G.; Vigier, J. P. (Paris-6 Univ., 75 (France). Inst. Henri Poincare). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 4, 459-461(14 Apr 1975). (In French)

The observation of type I supernovae in distant galaxies yields an homogeneous sample of sources to evaluate their true distance. An examination of their distribution in the sky provides a significant confirmation of the angular anisotropy of the Hubble constant already observed by Rubin, Rubin and Ford. (FR)

**12783** EXISTENCE AND UNIQUENESS OF STELLAR EQUILIBRIUM MODELS. Perdang, J. (Institut d'Astrophysique, Cointe-Ougree, Belgium). Astrophys. Space Sci.; 36: No. 1, 111-135(Aug 1975).

The stellar equilibrium equations for given surface pressure $P_*$ and temperature $T_*$, and in the absence of convection, are translated into a nonlinear integral equation, in which the radius R of the star enters as an eigenvalue. It is shown that under broad mathematical assumptions on the constitutive equations (equation of state, opacity and energy generation) a global existence and uniqueness property can be formulated. If a value $P_M$ is selected, which restricts the allowed pressure and temperature range $|P(r) - P_*| + E|T(r) - T_*| \leq P_M$ (E, arbitrary constant of dimensions of a pressure over temperature), then at least one solution P(r), T(r) exists in the pressure-temperature range chosen, for any $R < R_E$. This solution is unique for $R < R_c$. $R_E$ and $R_c$ are expressed in terms of the constitutive equations, and of the pressure-temperature range adopted. A physical argument in favour of the stability of this solution is presented. (auth)

**12784** FOURIER ANALYSIS OF THE LIGHT CURVES OF ECLIPSING VARIABLES. IV. Kopal, Z. (Manchester Univ. (UK)). Astrophys. Space Sci.; 36: No. 1, 227-237(Aug 1975).

The methods of analysis of the light changes of eclipsing variables in the frequency domain, developed in the previous papers (Kopal, 1975b, c) for total or annular eclipses of arbitrarily limb-darkened stars, have now been extended to the case of partial eclipses of occultation as well as transit type. The even Fourier sine coefficients are formulated - in the guise of the moments $A_{2m}$ of the light curve - in terms of the elements of the eclipse; and their use for a solution for the elements is detailed. Certain auxiliary tables to facilitate this task are included. An extension of the same method to an analysis of the light changes exhibited by close eclipsing systems - in which the photometric proximity effects arising from mutual distortion can no longer be ignored - will be given in the subsequent paper of this series. (auth)

**12785** EVOLUTION OF MASSIVE CLOSE BINARIES. II. The Post X-Ray Binary Stage: Origin of Run-Away and Binary Pulsars. de Loore, C.; de Greve, J. P.; de Cuyper, J. P. (095700). Astrophys. Space Sci.; 36: No. 1, 219-225(Aug 1975).

The further evolution of a massive X-ray binary consisting of a compact object and an OB supergiant is outlined. The supergiant exceeds its critical Roche lobe and a second stage of mass transfer starts. The remnant of the mass losing star—a pure helium star—develops a collapsing iron core and finally undergoes a supernova explosion. If the compact companion is a black hole the system remains bound; if the compact companion is a neutron star the system is disrupted unless an extra kick allowing an asymmetric explosion is given. Computations were performed for the massive binary 22.6 $M_\odot$ + 2 $M_\odot$. The possible final evolutionary products are: a black hole and a compact object, in a binary system, two run-away pulsars, a binary pulsar. As final parameters for the described system the eccentricity and period for the recently discovered binary pulsar 1913 + 16 may be found. An orbital inclination of i = 40° may be derived. The probability for the generation of binary pulsars is very low; in most cases the system is disrupted during the supernova explosion. (auth)

**12786** PARTICLE ACCELERATION AND RADIATION OUTPUT IN STOCHASTIC ELECTROMAGNETIC FIELDS. Lerche, I. (Chicago Univ., Ill. (USA). Enrico Fermi Inst.). Astrophys. Space Sci.; 36: No. 1, 205-217(Aug 1975).

It is demonstrated that when charged particles interact with a plane electromagnetic wave which possesses a random amplitude, then the particles are accelerated to high energy because they are pushed along by the wave's Poynting vector. Not only are they so accelerated, as they are carried along by the wave, but also they diffuse at right angles to the direction of the Poynting flux (i.e. in the direction of the wave's electric field). The ultimate energy that such particles can reach is determined when they radiate as much energy per unit time as they receive from the plane wave. For numbers believed typical of the Crab nebula this ultimate energy is of order $10^{19}$ $mc^2$. These calculations have been done to show that turbulent electromagnetic waves are quite efficient in generating high energy particles from low energy particles. Thus when the low frequency coherent waves emitted by a magnetized rotating neutron star are turned into incoherent waves because of wave-plasma interactions in a surrounding nebula, they still accelerate particles to rather high energies. Accordingly, while it obviously takes less time to produce high energy particles with a coherent wave than with a turbulent wave, the calculations given here show that the bulk of the relativistic electrons in the Crab nebula could still be energized by the turbulent remnants of a coherent wave. (auth)

**12787** PULSARS. II. Theories. Olsen, H. K. Fys. Tidsskr.; 73: No. 2, 49-55(1975). (In Danish).

Pulsars are explained to be rotating neutron stars and their properties are briefly discussed. Pulsars are the product of a supernova explosion. The development of Cen X-3 is thought to have started with a double star of the main series. Exchanges of mass take place between the two stars, in both directions. One of them becomes a supernova, explodes, becomes a pulsar, then the other star becomes a giant, and the exchange of mass is reversed. (JS)

**12788** QUADRATIC ZEEMAN EFFECT IN THE Ca II H AND K LINES. Kemic, S. B. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. (USA)). Astrophys. Space Sci.; 36: No. 2, 459-466(Sep 1975).

The effects of a large magnetic field on the H and K lines of Ca II are investigated incorporating both the linear and quadratic Zeeman effects for fields in the range $10^6$—$10^9$G. For these fields the linear term is the dominant one, resulting in a Pachen-Back effect with a smaller quadratic Zeeman shift superimposed on all components. Due to the partial cancellation of the quadratic effect between the upper and lower states of the lines, a much smaller quadratic Zeeman shift occurs than in the lines of other atoms previously studied at similar fields. (NL)

**12789** ORIGIN OF THE EMISSION LINES SHOWN BY RW TAURI AND OTHER BINARY SYSTEMS. Wu, C. C. (Wisconsin Univ., Madison (USA)). Astrophys. Space Sci.; 36: No. 2, 407-426(Sep 1975).

It is proposed that the observed double-component emission lines originate from the triangular Lagrangian points, L4 and L5, of the restricted, three-body problem. The light curves of many close binary systems show absorption dips at ±60° of the primary (and sometimes also the secondary) minimum, indicating appreciable accumulation of matter at these points. The orbital velocity of L4 and L5 is derived as a function of period and the masses of the component stars. This equation is an independent relationship for determining the two stellar masses. It also reproduces Struve's empirical finding of $V^3$ varies as $p^{-1}$. The observed line velocity is consistently higher than the calculated orbital of L4 and L5. This is due to the serious erosion of the low velocity sides of the emission components by the stellar and shell absorption lines. There are observational evidences which indicate the intermittent high velocity radial ejection of matter to be a mode of mass loss from the secondary. And the energy of mass motion from this ejection is sufficient, and may be responsible, for heating the gas at L4 and L5. The ionizing radiation emitted by the primary of the Algol systems is many orders of magnitude below that required by the observed strength of the emission lines. Some related discussion is also given to nova and dwarf nova systems. (NL)

**12790** DISCUSSION OF SIMPLE STABILITY CRITERIA FOR STARS WITH CENTRAL HELIUM BURNING. Gabriel, M. (Institut d'Astrophysique, Cointe-Ougree, Belgium); Refsdal, S.; Ritter, H. (Hamburger Sternwarte, Hamburg, F. R. Germany). Astrophys. Space Sci.; 36: No. 2, 439-450(Sep 1975).

The validity of simple stability criteria for stars with central He-burning used in earlier papers is investigated. The determinant of secular stability for $\sigma = 0$ is related to quantities defined as far as possible at the surface of the He-core and at the bottom of the envelope. This relation is used to discuss the validity of two intuitive criteria for secular stability. (NL)

**12791** SPECTROGRAPHIC STUDY OF THE ECLIPSING BINARY SYSTEM SZ CAMELOPARDALIS. Budding, E. (Tokyo Univ., Mitaka (Japan). Tokyo Astronomical Observatory). Astrophys. Space Sci.; 36: No. 2, 329-343(Sep 1975).

Thirteen high-dispersion spectrographs of the eclipsing binary star SZ Cam have been studied with a view of determining more accurate information on: the spectral type and luminosity clas-

sifications, absolute parameters for the component stars, the stellar environment of SZ Cam. The main results in these categories are as follows: 09.5 Vnk, $m_g = 19 \pm 2$ solar masses, $m_g = 6.5 \pm 1$ solar mass, $r_g = 9.7 \pm 3.6$ solar radii, $r_g = 4.8 \pm 1.7$ solar radii, $T_e \sim 30000$ K, $T_e \sim 23000$ K; there is a local concentration of absorbing material which may reach a density of 2 solar masses $pc^{-3}$, and the distance of the star is found to be $600 \pm 150$ pc. The determined overluminosity of the secondary star and the local concentration of absorbing material are two topics which provide the basis for a discussion section. (NL)

**12792** SPECTROSCOPIC OBSERVATIONS OF ZETA AURIGAE DURING THE 1971-72 ECLIPSE. II. Intensity of the Chromospheric K-line and Radial Velocities of Chromospheric Lines. Kawabata, S. (Kyoto Gakuen University, Kameoka, Kyoto, Japan); Saito, M. (Tokyo Univ., Mitaka (Japan). Tokyo Astronomical Observatory). Astrophys. Space Sci.; 36: No. 2, 273-280(Sep 1975).

The chromospheric phases in the 1971-72 eclipse were observed at wavelength regions containing the K-line of ionized calcium on six nights at ingress and on eight nights at egress at the Okayama Astrophysical Observatory. The linear dispersion of the spectrograms is about 10 $Amm^{-1}$. The spectrograms were measured for line intensities of the K-line and for radial velocities of metallic and hydrogen lines. The results are compared with those obtained in the earlier eclipses. The intensities of the chromospheric K-lines during this eclipse were relatively "weak" at both ingress and egress and were similar to those in the 1939-40 eclipse. It seems that the chromospheric activity of zeta Aurigae increased after 1939, reached a maximum at 1950-56 and then decreased again until 1971. The radial velocities of the chromospheric lines of hydrogen atoms, ionized calcium and some other atoms and ions varied with phase showing almost the same characteristic features as in most earlier eclipses. Intensities and velocities were also measured for satellite lines of the K-line. (NL)

**12793** SHOCK PROPAGATION THROUGH AN ATMOSPHERIC MODEL OF AN RR LYRAE TYPE STAR. Okuda, T. (Kyoto Univ.). Mem. Fac. Sci., Kyoto Univ., Ser. Phys., Astrophys., Geophys., Chem.; 34: 261-273(Oct 1974).

The propagation of shock waves through a model atmosphere of an RR Lyrae type star is examined on the basis of Brinkley–Kirkwood method. The effects of gravity, radiation pressure and variation of specific heat ratio with depth are taken into consideration. It is supposed that a shock wave is generated below the convective region with the shock strength and shock energy taken as parameters. The numerical results show that the shock strength remains almost constant in the convective region while it abruptly increases from the top of this region toward the outer surface. The results are generally in good agreement with those of Sachdev and others. A brief discussion on the validity of our calculations of shock propagation is also presented. (auth)

**12794** X RAYS FROM SUPERNOVA REMNANTS. Charles, P. A.; Culhane, J. L. Sci. Am.; 233: No. 6, 38-46(Dec 1975).

The mechanisms of x-ray emission from supernova remnants are discussed. Although the pulsar in the Crab Nebula remains unchallenged as the power source for the entire object, x-ray maps strongly suggest that the electrons are accelerated again to the body of the nebula away from the pulsar. Moreover, young remnants such as Casseopeia A and the remnant of Tyco's nova seem to comprise large amounts of hot gas radiating x-rays, contradicting earlier suggestions that the x-rays were emitted by the synchrotron process. (BJG)

## Quasi-Stellar, Radio, and X-Ray Sources

*Refer also to abstracts 12794, 12851, and 12853.*

**12795** HIGH-ENERGY ASTRONOMY. Koch-Miramond, L. Recherche (Paris); 6: No. 52, 25-35(Jan 1975). (In French)

The X and gamma sources detected in the universe, non-periodic or periodic, are reviewed. Theoretical considerations lead to the question of whether the existence of black holes and anti-matter will be demonstrated. (FR)

**12796** CRYOPUMPED SUPERSONIC MOLECULAR BEAM SOURCE. Habets, A. H. M.; Beijerinck, H. C. W.; Verster, N. F. (Technische Hogeschool Eindhoven (Netherlands)). pp 93-99 of Comptes Rendus Du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From 4th International symposium on the molecular beams; Cannes, France (9 Jul 1973).

Design of a supersonic source with a plane skimmer and a cryopumped expansion chamber is described. Performance measurements of the cryopump were done using flow rates up to 5 torr l/s for Ar and $N_2$. Absolute centerline beam intensities and off-centerline intensity-profiles were determined. With argon a centerline intensity of 4.7 $10^{18}$ molecules $sterad^{-1}s^{-1}$ was obtained at a nozzle flow of 8.2 $10^{18}$ molecules $s^{-1}$. (FR)

## Solar Phenomena

*Refer also to abstract 12894.*

**12797** (BUP-68) RECORDINGS OF SOLAR PROTONS DURING OCTOBER 26–29, 1968. Gjerde, A.; Amundsen, R. (Bergen Univ. (Norway). Dept. of Physics). Aug 1974. 28p. Dep. NTIS (US Sales Only) $5.00.

The composite events causing increased influx of solar particles during October 26-29, 1968 are studied using data from the polar orbiting ESRO IA satellite. Details on protons of 0.1–10 MeV are presented, and their interplanetary propagation characteristics discussed. Diffusion model fit to the prompt event commencing October 26 suggests an interplanetary diffusion coefficient for 200-350 keV protons of $(2.8 \pm 0.7) \cdot 10^{20} cm^2 s^{-1}$. The most likely parent flare for this event is the 1N flare of 0119 UT October 26, occurring in McMath plage region 9740 at 32°E solar longitude. The slow decay of event is then accounted for by co-rotation effects. The flares occurring in the same solar region on October 27 and leading to the delayed events of October 29 did not result in prompt events seen near Earth, showing the great variability in energetic particle propagation conditions of interplanetary space. (auth)

**12798** (N-72-18792) SPATIAL AND SPECTRAL STUDIES OF SOLAR PHENOMENA. Final Report, September 1970–August 1971. Harvey, K. L.; Kulander, J. L.; Martin, S. F.; Ramsey, H. E. (Lockheed Solar Observatory, Burbank, Calif. (USA)). Sep 1971. Contract NASw-2160. 49p. (NASA-CR-125607; LMSC/D-24368). NTIS.

Work proceeded simultaneously in four different areas of solar research. These were: assembly and testing of the components of a multiple-slit H alpha spectrograph, simultaneous observations of the wings of the H alpha line with a newly modified filter, analysis of H alpha high resolution observations in conjunction with magnetic field observations obtained at Kitt Peak, and theoretical analysis of the D3 line HeI. (auth)

**12799** (N-75-17274) SOLAR RADIO CONTINUUM STORMS. (Washington Data Processing, Inc., Riverdale, Md. (USA)). Dec 1974. 57p. (NASA-CR-139176. NTIS $4.25.

Radio noise continuum emission observed in metric and decametric wave frequencies is discussed. The radio noise is associated with actively varying sunspot groups accompanied by the S-component of microwave radio emissions. It is shown that the S-component emission in microwave frequencies generally occurs several days before the emission of the noise continuum storms of lower frequencies. It is likely that energetic electrons, 10 to 100 KeV, accelerated in association with the variation of sunspot magnetic fields, are the sources of the radio emissions. A model is considered to explain the relation of burst storms on radio noise. An analysis of the role of energetic electrons on the emissions of both noise continuum and type III burst storms is presented. It is shown that instabilities associated with the electrons and their relation to their own stabilizing effects are important in interpreting both of these storms. (auth)

**12800** (N-75-17275) SOLAR RADIO CONTINUUM STORMS AND A BREATHING MAGNETIC FIELD MODEL. Final Report. (Washington Data Processing, Inc., Riverdale, Md. (USA)). Jan 1975. Contract NAS5-20739. 51p. (NASA-CR-139178). NTIS $4.25.

Radio noise continuum emissions observed in metric and decametric wave frequencies are, in general, associated with actively varying sunspot groups accompanied by the S-component of microwave radio emissions. These continuum emission sources, often called type I storm sources, are often associated with type III burst storm activity from metric to hectometric wave frequencies. This storm activity is, therefore, closely connected with the development of these continuum emission sources. It is shown that the S-component emission in microwave frequencies generally precedes, by several days, the emission of these noise continuum storms of lower frequencies. In order for these storms to develop, the growth of sunspot groups into complex types is very important in addition to the increase of the average magnetic field intensity and area of these groups. After giving a review on the theory of these noise continuum storm emissions, a model is briefly considered to explain the relation of the emissions to the storms. (auth)

**12801** LOCALIZATION OF BEAM AND CONICAL INSTABILITIES IN AN ADIABATIC MAGNETIC TRAP. Ledenev, V. G.

Issled. Geomagn., Aeron. Fiz. Solntsa; No. 31, 78-84(1974). (In Russian)

A study is made of the localization of certain types of high frequency electrostatic instabilities excited in an adiabatic magnetic trap by counterflows of high energy electrons. It is demonstrated that the Cherenkov instability develops in the center of the trap (in the region of minimum intensity), and the most favorable conditions for the development of the conical instability occur at some distance from it. The results obtained permit a qualitative explanation of the division of the moving burst of solar radiowave length emission of the fourth type into several sources. (auth)

**12802** THE POSSIBILITY OF DEDUCING INTERPLANETARY AND SOLAR PARAMETERS FROM GEOMAGNETIC RECORDS. Russell, C. T. (California Univ., Los Angeles (USA). Inst. of Geophysics and Planetary Physics). Sol. Phys.; 42: No. 1, 259-269(May 1975).

While at present we are able to deduce from ground records only qualitative properties of the solar wind, in the future quantitative deductions may be possible, in a statistical sense, from an examination of polar cap magnetograms together with records of geomagnetic activity. The qualitative inferences that are possible now indicate several important features of the behaviour of the solar wind over the last 100 years. First there appear to be significant long term changes in either the solar wind velocity, the magnetic field strength, the variability of the field or some combination of all three. Second, a heliographic latitude dependence of the parameters exists, whose amplitude depends on sunspot number. Third with the exception of the most recent solar cycle, there is little north-south asymmetry in these solar parameters. Finally, there is a double sunspot cycle modulation of geomagnetic activity, the most likely cause of which is a modulation of the interplanetary magnetic polarity with latitude, and which in turn implies the pressure of a solar polar magnetic dipole. The amplitude of this modulation has undergone significant changes since 1868, being large then and at the present, but effectively disappearing from 1908 to 1948. (auth)

**12803** TYPE III SOLAR BURSTS AND THE FUNDAMENTAL-HARMONIC HYPOTHESIS. Rosenberg, H. (Harvard Coll. Observatory, Cambridge, Mass. (USA)). Sol. Phys.; 42: No. 1, 247-257(May 1975).

The observational evidence is reviewed for the occurrence of type III solar radio bursts in pairs with frequency ratio two to one. It is shown that the observations can be explained under the hypothesis that there is a tendency for a type III burst to be followed by a second burst within approximately one second. This explanation leads to fewer difficulties than the hypothesis that type III bursts occur in pairs, one member being emitted at the fundamental of the local coronal plasma frequency, the other at its second harmonic. It is concluded that in general, type III bursts are emitted at the second harmonic of the plasma frequency and that type III theories should account for this and only under very special circumstances (which are rare) for the emission at the fundamental and the second harmonic. (auth)

**12804** X-RAY HEATING OF A LOW-TEMPERATURE REGION IN CHROMOSPHERIC FLARES. Somov, B. V. (AN SSSR, Moscow. Fizicheskij Inst.). Sol. Phys.; 42: No. 1, 235-246(May 1975).

Part of the proper X-ray emission of a flare is absorbed in the chromosphere and heats the region which creates an optical (in particular $H_\alpha$) flare emission. The heating of chromosphere by X-ray emission may be responsible for the diffuse halo around the flare kernels. The optical emission of flare kernels, whose main sources of heating are energetic particles and/or thermal fluxes may be also increased. By simple model calculations the present paper discusses the possibility of such effects for the large flare of 1972 August 7. (auth)

**12805** ANISOTROPY AND POLARIZATION OF SOLAR X-RAY BURSTS. Henoux, J. C. (Observatoire de Paris, Section de Meudon, 92 (France)). Sol. Phys.; 42: No. 1, 219-233(May 1975).

The effects of the Compton back-scattered X-ray flux from the photosphere on the directivity and polarization of flare X-rays between 15 keV and 150 keV are computed. The calculations are made with a thin target model for flares of De Jager-Kundu type with electrons spiralling downward around a vertical magnetic field and for an isotropic source. The resulting polarization for an isotropic source is not higher than 4%. The resulting directivity of anisotropic sources is greatly reduced, particularly below 70 keV. The results of the statistical studies of the center-limb distribution of solar X-ray bursts are then compatible with the existing measures of polarization. The hypothesis for existence of De Jager-Kundu type flares is enforced. (auth)

**12806** CHANGES OF THE H$\alpha$ FIBRIL PATTERN DURING SOLAR FLARES. Bruzek, A. (Fraunhofer Institut, Freiburg, F. R. Germany). Sol. Phys.; 42: No. 1, 215-217(May 1975).

A pattern of parallel H$\alpha$ fibrils inside a network cell changed into a pattern of vertical or radial fibriles after a flare had covered the region. This may be evidence for a change of the magnetic configuration during flare occurrence. (auth)

**12807** THE X-RAY LINE AND CONTINUUM EMISSION FROM A SOLAR ACTIVE REGION. Landecker, P. B. (Aerospace Corp., El Segundo, Calif. (USA). Space Physics Lab.); Wolff, R. S. (Columbia Univ., New York (USA)). Sol. Phys.; 42: No. 1, 209-214(May 1975).

The X-ray spectrum of the quiet Sun in the energy range 2.3–6.9 KeV was observed from an Aerobee rocket using an uncollimated graphic crystal spectrometer. These results and spatial measurements made with an onboard modulation collimator are analyzed using solar models. Several methods of estimating coronal temperatures are used in the analysis and all yield results within the range $(4 \pm 1) \times 10^6$K. (auth)

**12808** THE ANALYSIS OF A HIGH RESOLUTION X-RAY SPECTRUM OF A SOLAR ACTIVE REGION. Parkinson, J. H. (University Coll., London (UK). Mullard Space Science Lab.). Sol. Phys.; 42: No. 1, 183-207(May 1975).

Absolute intensities and wavelengths for 98 X-ray emission lines between 9 and 22.5 Å are reported. The active region spectra were obtained with three rocket-borne crystal spectrometers. Indentifications are proposed for 62 of the lines and a model of the emitting plasma is constructed from the intensities of the strongest lines. The emission measure ($Ne^2$ V) of the model peaks at $3 \times 10^6$K with a value of $1.5 \times 10^{47}$ cm$^{-3}$ and decreases to $10^{46}$ cm$^{-3}$ at $5 \times 10^6$K. Effective oscillator and collision strengths are calculated for the other transitions that are observed. The relative intensities of O VIII and Ne IX give an oxygen: neon abundance ratio of 8:1. The intensities of the satellite lines to helium-like lines are investigated and it is shown that these lines can be used with confidence in constructing active region models. (auth)

**12809** RADIO EVIDENCE FOR AN EXPANDING MAGNETIC ARCH BEYOND 20 SOLAR RADII. Stone, R. G.; Fainberg, J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sol. Phys.; 42: No. 1, 179-181(May 1975).

A magnetic loop located beyond 20 $R_\odot$ appears to be the later evolution of an expanding magnetic arch observed at 2 $R_\odot$. The expansion speed is of the order of 100 km s$^{-1}$. (auth)

**12810** THE LARGE CORONAL TRANSIENT OF 10 JUNE 1973. I. Observational Description. Hildner, E.; Gosling, J. T.; MacQueen, R. M.; Munro, R. H.; Poland, A. I.; Ross, C. L. (National Center for Atmospheric Research, Boulder, Colo. (USA)). Sol. Phys.; 42: No. 1, 163-177(May 1975).

During the 8.5 month flight of the High Altitude Observatory's white light coronagraph on board Skylab, over 100 coronal transients were observed. In this paper a description is presented of one well observed loop transient, that of 10 June 1973. The transient apparently resulted from the eruption of a quiescent prominence on the limb—the emergence of a new, bipolar active region near the prominence may have caused the eruption. The transient's leading edge rose from 3.6 to 5.0 solar radii ($R_\odot$) from Sun center at approximately 500 km s$^{-1}$ during the 32 min of coronograph observations. Material in a pre-existing streamer was swept away by the transient, causing the streamer to disappear. The mass ejected into the corona above a projected height of 2 $R_\odot$ was $\sim 5.4 \times 10^{15}$g, the potential energy associated with the ejected transient material was $\geq 7.0 \times 10^{30}$erg, and the kinetic energy of the ejected material is estimated as $1.7 \times 10^{30}$ erg. The 10 June 1973 transient was, in most respects, typical of other loop transients observed by Skylab. (auth)

**12811** A CORONAL HOLE OBSERVED AT 10.7 GHz WITH A LARGE SINGLE DISH. Fuerst, E. (Max-Planck-Institut fuer Radioastronomie, Bonn (F. R. Germany)); Hirth, W. (Bonn Univ. (F. R. Germany). Astronomische Institute). Sol. Phys.; 42: No. 1, 157-161(May 1975).

On July 24, 1973, a coronal hole was observed at 10.69 GHz (2.8 cm) with the Bonn 100-m telescope. The difference of the brightness temperature between outside and inside the hole was about 400 to 500 K. It is shown that this lack of emission can be explained by usually adopted values of the electron density at the bottom of the corona. (auth)

**12812** THE STRUCTURE AND EVOLUTION OF CORONAL HOLES. Timothy, A. F.; Krieger, A. S. (American Science and Engineering, Inc., Cambridge, Mass.); Vaiana, G. S. (Harvard Coll. Observatory, Cambridge, Mass. (USA)). Sol. Phys.; 42: No. 1, 135-156(May 1975).

When observed at soft X-ray wavelengths coronal holes are seen as open features, devoid of X-ray emission and bounded by apparently divergent coronal loop structures. Inspection of the topology of the photospheric magnetic fields associated with these features suggests that holes are formed when the remnants of active region fields, emerging in both hemispheres over a period of several solar rotations, combine to form a large area of essentially unipolar field. Remnants of opposite polarity fields surround these features resulting in a divergent magnetic configuration at the hole boundaries. Holes are seen to form and evolve while the large scale divergent field pattern is reinforced and to close when large scale remnants occur which disrupt the general field pattern. Two types of holes are observed in the early Skylab observations. The first are elongated features which are aligned approximately north-south extending from one solar pole to a polar filament channel in the opposite hemisphere. The polar holes and somewhat lower latitude holes appear to lie in unipolar areas which are completely confined by opposite polarity fields. Studies of the rotation properties of an elongated hole, which extended from the north pole to a latitude of approximately 20°S, showed it to rotate with a synodic rate of $(13.25 \pm 0.03) - (0.4 \pm 0.1 \sin^2 \phi$ deg day$^{-1})$. Possible explanations for the almost rigid rotational characteristics of this feature are discussed. (auth)

**12813** OBSERVATION OF A NON-UNIFORM COMPONENT IN THE DISTRIBUTION OF CORONAL BRIGHT POINTS. Golub, L.; Krieger, A. S. (American Science and Engineering, Inc., Cambridge, Mass.); Vaiana, G. S. (Harvard Coll. Observatory, Cambridge, Mass. (USA)). Sol. Phys.; 42: No. 1, 131-134(May 1975).

The longitude distribution of X-ray bright points shows very strong variations when plotted in a heliocentric (Carrington) coordinate system. In addition, the latitude distribution can be interpreted as having two components: a uniformly distributed component and one having a distribution similar to that of active regions, occurring mostly within ±30° of the equator. (auth)

**12814** COMMENTS ON THE COURSE OF SOLAR ACTIVITY DURING THE DECLINING PHASE OF SOLAR CYCLE 20 (1970-74). Dodson, H. W.; Hedeman, E. R. (McMath-Hulbert Observatory, Univ. of Michigan, Pontiac, Mich., USA). Sol. Phys.; 42: No. 1, 121-130(May 1975).

In the declining phase of solar cycle 20 (1970-74) three pulses of activity occurred and resulted in two well defined "stillstands" in the smoothed means of sunspot., 2800MHz, and calcium plage data. Marked diminutions in spot and 2800MHz flux took place in 1970 and 1971, respectively, and were accompanied by concomitant decreases in flare-occurrence. Studies of the latitude distribution of spots and flares show the extent of the dominance of the northern hemisphere in cycle 20 and the marked phase shift between northern and southern hemispheres. In the years studied, the longitudes of centers of activity clustered in identifiable zones or hemispheres for relatively long intervals of time. From mid-1973 to mid-1974 the Sun had a relatively inactive hemisphere centered on ~0° longitude. The relationship of certain well defined "coronal holes" to this inactive hemisphere of the chromosphere is noted. The first two spot groups of the new cycle formed in November 1974 and January 1975 in the longitude zone associated with relatively high levels of old cycle activity, a repetition of the pattern observed in 1963-64. (auth)

**12815** ON THE TURBULENT DECAY OF STRONG MAGNETIC FIELDS AND THE DEVELOPMENT OF SUNSPOT AREAS. Krause, F.; Ruediger, G. (Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Astrophysik). Sol. Phys.; 42: No. 1, 107-119(May 1975).

This paper deals with the conception that two-dimensional turbulence is present in a sunspot where the magnetic field is strong. This conception is based upon the incapacity of even a strong magnetic field to influence an arbitrary two-dimensional turbulence, if the magnetic field is parallel to a constant direction and the motion occurs in planes orthogonal to it. It is, moreover, shown that such a two-dimensional turbulence provides for a turbulent decay of the magnetic field. The decay rate possesses nearly the same dependence on the scales as for three-dimensional turbulence. Finally, the turbulent decay is studied by investigating a simple model and comparing the results with those deduced by Bumba from the observed decay of sunspot groups areas. By means of our conception even a good quantitative agreement is stated. (auth)

**12816** A MODEL OF THE SUPERGRANULATION NETWORK AND OF ACTIVE-REGION PLAGES. Stenflo, J. O. (Lund Observatory, Lund, Sweden). Sol. Phys.; 42: No. 1, 79-105(May 1975).

Analysis of magnetograph recordings made simultaneously in different spectral lines have shown that the quiet-region network and active-region plages with average field strengths less than about 100 G are made up by the same type of elementary structures, each having the same physical properties. Magnetograph data are used together with continuum, line profile, and EUV data to derive a model of these subarcsec, spatially unresolved elementary structures. The field strength at the center of each basic element is about 2 kG. The temperature enhancement starts at a height of about 180 km (above the level $\tau_0 = 1$ in HSRA), and increases rapidly with height. The brightness structures are coarser than the magnetic-field structures. The magnetic field cannot be contained by either gas pressure or dynamic pressure. The magnetic pressure must be balanced by the constricting force of strong electric currents along the magnetic filaments (pinch effect). A mechanism is proposed for the amplification of the field, involving vortex motions around the downdrafts in the network and plages. Efficient heating by hydromagnetic waves builds up an excess gas pressure inside the twisted fluxropes. The excess pressure is released by the ejection of spicules, which have to move out along the helically shaped field lines and thereby will acquire a spinning motion. The continuum emission in the fluxropes, which are located in the intergranular lanes, washes out the contrast between cell interiors and cell boundaries and creates an abnormal granulation pattern. When more and more magnetic flux is brought into a given area, the interaction between the fluxropes and the granulation starts to change the physical structure of the fluxropes. This begins at an average field $B_{obs} \sim 100$ G, with a gradual transition to pores and sunspots as $B_{obs}$ is increased. (auth)

**12817** EMISSION OF HELIUM IN PROMINENCES AND THE CHROMOSPHERE. Morozhenko, N. N. (AN Ukrainskoj SSR, Kiev). Sol. Phys.; 42: No. 1, 71-78(May 1975).

The excitation of the levels $2^1P$, $3^1D$, $5^1D$, $6^1D$ and $7^1D$ of helium in quiescent prominences and the chromosphere is considered using the observations made during the 1952, 1961 and 1970 solar eclipses (Thomas and Athay, 1961; Athay and Orrall, 1957; Rigutti and Russo, 1964; Kubota et al., 1972) as well as by means of high altitude coronographs (Jeffries and Orrall, 1962). It is shown that the lower levels of the singlet series of helium, like the lower levels of hydrogen, are excited by resonance ($\lambda = 584$ Å) and photospheric radiation. The higher levels are populated by transitions from the triplet system, so that a relative state LTE is established between the systems for $n \geqq 6$. (auth)

**12818** ON THE SPICULAR DENSITY ENHANCEMENT IN THE REGION OF FORMATION. Sahai, S. K.; Bessey, R. J. (Wyoming Univ., Laramie (USA)). Sol. Phys.; 42: No. 1, 67-70(May 1975).

The possibility is examined of putting an upper limit on the density enhancement of the spicules as compared to the surroundings, in the region of their formation. (auth)

**12819** INTERPRETATION OF Hα CONTRAST PROFILES OF CHROMOSPHERIC FINE STRUCTURE. Cram, L. E. (National Measurement Lab., Sydney (Australia)). Sol. Phys.; 42: No. 1, 53-66(May 1975).

Recent observations of the Hα contrast profiles of identifiable chromospheric fine structures are interpreted in terms of an empirical model. It is shown that the parameters inferred from an application of Beckers' "cloud" model are unreliable, and the problem of line asymmetries is re-examined. Quantitative models for the Hα chromosphere near the limb suggest that the "dark band" phenomenon is due to low opacity in the neighborhood of the temperature minimum, while the peculiar appearance of mottle contrast profiles near the limb is explained in terms of foreground absorption. (auth)

**12820** HEIGHT OF HELIUM EMISSION IN THE CHROMOSPHERE. Pope, T.; Schoolman, S. A. (Lockheed Solar Observatory, Rye Canyon, Calif., USA). Sol. Phys.; 42: No. 1, 47-51(May 1975).

Filtergrams of the limb show the HeI $D_3$ chromosphere as a shell which is separated from the limb by a gap. The height of maximum $D_2$ contribution occurs at about 1350 km above the limb and is independent of the intensity of the $D_3$ emission. This effect is interpreted as the height to which coronal EUV radiation is capable of penetrating the atmosphere. (auth)

**12821** SUPPLEMENTARY REMARKS TO "ON THE AVERAGE DEPTH OF FORMATION OF WEAK FRAUNHOFER LINES" BY E. GURTOVENKO, V. RATNIKOVA AND C. DE JAGER. Gurtovenko, E. A.; Ratnikova, V. A. (AN Ukrainskoj SSR, Kiev). Sol. Phys.; 42: No. 1, 43-45(May 1975).

In a previous article (Gurtovenko et al., 1974) it has been shown that the contribution Fe to the line emission fails to give the right average depth of line formation. The computation example in this note once more confirms that statement. The profiles of weak lines appear to be very sensitive to the photospheric motion field. The photosphere is split into layers with equal geometrical

thickness (~43km), every layer including four τ-intervals in the HSRA model. Using the observed central depression $d_c$ of weak $T_i$ line at 6098.664 Å the product L = gFA is computed with the HSRA model and a constant "microturbulent" velocity 2km $s^{-1}$. Later the calculations of $d_c$ were repeated with L-value and with "turbulent" velocities increased from 2km $s^{-1}$ to 6 $kms^{-1}$ in each layer successively. The results show that the maximum influence to $d_c$ is by the layers $0.1 < \tau_5 < 0.4$ ($0.11 < \tau_\lambda < 0.44$). (auth)

**12822** OBSERVATION OF THE ABSOLUTE INTENSITY OF THE SUN ON THE VACUUM ULTRAVIOLET REGION. Nishi, K. (Tokyo Astronomical Observatory, Mitaka, Tokyo, Japan). Sol. Phys.; 42: No. 1, 37-42(May 1975).

The absolute intensity of the solar spectrum between 1550 Å and 1950 Å was measured photoelectrically by a rocketborne spectrometer flown from the Kagoshima Space Centre on 19 February 1973. The spectrometer was a single dispersive type with uniaxial Sun-pointer, and the absolute intensity from the whole disk with a 78 Å spectral resolution was measured. The result was consistent with previous observation. (auth)

**12823** MAGNETOACTIVE LINES IN THE MEDIUM WITH THE VELOCITY GRADIENT. Grigorjev, V. M.; Katz, J. M. (AN SSSR, Irkutsk. Sibirskij Inst. Zemnogo Magnetizma Ionosfery i Rasprostraneniya Radiovoln). Sol. Phys.; 42: No. 1, 21-35 (May 1975).

The magnetic splitting peculiarities of the absorption lines in the sunspot spectrum are considered. The most common and typical of them is breaking of all Stokes parameter symmetry in regard to the line center. The possible reason of this effect is the macroscopic gas motion with inhomogeneous velocity. Computed contours are given for the line Fe 1λ5250 Å with various combinations of magnetic and velocity fields. Magneto-optical effects within the line which are connected with the magnetic and velocity field inhomogeneity are discussed. The observation results are discussed for longitudinal magnetic field zero lines. These observations were carried out for the sunspot and photosphere in two spectral lines Fe Iλλ5250 and 5233 Å. In the sunspot the regular displacement of one zero line with respect to the other zero line takes place whereas in the photosphere the displacements are random. The possible reason of the regular displacement is the change of the magnetic field direction in the different optical layers wherein corresponding spectral lines are formed effectively. The connection between the zero line displacement of a longitudinal magnetic field and the crossover effect is discussed. The computation results are given which agree with observations and illustrate the above-mentioned relationship. The influence of the Stoke parameter asymmetry on the measured magnetic field signals is considered. (auth)

**12824** ISOTOPES OF SAMARIUM IN THE SUN. Ekeland, A.; Hauge, O. (Institute of Theoretical Astrophysics, Oslo (Norway)). Sol. Phys.; 42: No. 1, 17-20(May 1975).

Terrestrial samarium consists of seven isotopes. Some spectral lines from Sm have isotope shifts and hyperfine structures that will modify the profile of the absorption lines in the Fraunhofer spectrum. The photospheric spectrum around the Sm II lines at 4467 and 4519 Å has been studied. Although it is impossible to derive the solar abundance of each individual isotope, it is shown that a terrestrial isotopic composition can account for the anomalous line width and asymmetry of the observed solar lines. The solar abundance found from the two lines is A(Sm) = 1.54 in the logarithmic A(H) = 12.00 scale. (auth)

**12825** DIFFERENTIAL ROTATION, MERIDIONAL AND RANDOM MOTIONS OF THE SOLAR $Ca^+$ NETWORK. Schroeter, E. H.; Woehl, H. (Goettingen Univ. (F. R. Germany)). Sol. Phys.; 42: No. 1, 3-16(May 1975).

From high precision computer controlled tracings of bright $Ca^+$-mottles differential rotation, meridional and random motions of these chromospheric fine structures were investigated. The equatorial angular velocity of the $Ca^+$-mottles agrees well with that of sunspots (14°50 per day, sidereal) and is 5% higher than for the photosphere. The slowing down with increasing latitude is larger than for sunspots. Hence in higher latitudes $Ca^+$-mottles rotate as fast as the photospheric plasma. A systematic meridional motion of about 0.1 km $s^{-1}$ for latitudes around 10° was found. The $Ca^+$-mottles show horizontal random motions due to the supergranular flow pattern with an rms velocity of about 0.15 km $s^{-1}$. The correctness of the solar rotation elements i and Ω derived by Carrington (1863) were investigated. (auth)

**12826** ABUNDANCE OF Fe RELATIVE TO H AT 1.5 SOLAR RADII. Nakada, M. P.; Chapman, R. D.; Neupert, W. M.; Thomas, R. J. (National Aeronautics and Space Administration, Greenbelt, Md. (USA). Goddard Space Flight Center). Sol. Phys.; 42: No. 2, 487-496(Jun 1975).

The abundance of Fe relative to H is obtained by using resonantly scattered intensities of λ284 of Fe XV that were measured with OSO-7 and resonantly scattered intensities of Lα of H I that were obtained by Gabriel (1971). Because of possible differences in electron densities along lines of sight for these non-simultaneous measurements and in relative calibrations, results are rather uncertain but still indicate that the average Fe abundance relative to H in the corona appears to be at least as large as a recent photospheric abundance. Some limitations in using this method for obtaining abundances are examined for future experiments with simultaneous measurements and well calibrated detectors. (auth)

**12827** DECAMETER STORM RADIATION. I. Gergely, T. E.; Erickson, W. C. (Maryland Univ., College Park (USA)). Sol. Phys.; 42: No. 2, 467-486(Jun 1975).

A log-periodic array, 3 km long in the E-W direction is in operation at the Clark Lake Radio Observatory. The solar brightness distribution is swept once per second in the 65-20 MHz frequency range. The analysis of the interferometer records allows the determination of one dimensional solar burst positions, to an accuracy of 0.1 $R_\odot$ at 60 MHz and 0.3 $R_\odot$ at 30 MHz, approximately. Six long duration noise storms have been observed over an eight month period. extending from January to September, 1971. The storms are described and their relation to chromospheric active regions and flares is discussed. Decametric storms are found to be related to complexes of interacting active regions. The interaction is studied in terms of the number of "simultaneous" flares observed to occur in the various active regions. On the average, twice as many "simultaneous" flares are observed than would be expected if flares occurred at random. An analysis of coronal magnetic field maps computed from longitudinal photospheric fields shows magnetic arcades and some divergent field lines at the site of storm regions. Decimeter and meter wavelength sources are found to be associated with all decameter storms. At decimeter wavelengths double or multiple sources are often seen above individual active regions forming part of the chromospheric complex. (auth)

**12828** DISCUSSION ON THE CORONAL STRUCTURE RELATED TO TYPE III BURSTS. Pick, M.; Martres, M. J.; Axisa, F.; Mercier, C. (Observatoire de Paris, Section de Meudon, 92 (France)). Sol. Phys.; 42: No. 2, 461-466(Jun 1975).

Some statements recently published on the coronal structure related to type III bursts are discussed. The indirect approach based upon computed coronal magnetic field, as proposed by Kuiper (1973), is examined; it is concluded that some doubt exists about the suitability of this method. The problem of the relationship between the existence of filaments inside an active center and type III bursts production is analysed: considering the respective locations of flaring sites and filaments as well as their place inside the magnetic network of the active center, one cannot deduce any evidence of type III inhibition by filaments. There is no direct conclusive evidence of the association of type III's with known coronal structures. Some observations suggest that at least in some cases, the coronal streamers are involved. (auth)

**12829** SOURCE REGIONS FOR TYPE II RADIO BURSTS. Dodge, J. C. (Colorado Univ., Boulder (USA). Dept. of Astro-Geophysics). Sol. Phys.; 42: No. 2, 445-459(Jun 1975).

The flares associated with reported type II bursts from 1964-1973 (hereafter abbreviated source-flares) are analyzed with respect to their importance, duration, and heliographic distribution. The source-flares for type II bursts generally are normal to small in area and normal to brilliant in intensity; however, they have slightly longer durations than would be expected from flares with such small areas. Flares associated with type II bursts are distributed uniformly east and west of the central meridian. This implies that type II bursts cannot be narrow-beamed, radially-propagating radio emitters. The latitude of the occurrence of source-flares shows a drift with time that is not significantly different from that of sunspots. The drift rate is a maximum during the period of maximum solar activity. The heliographic distribution of source-flares shows large-scale organization into similarly shaped regions (source-regions) separated by 180° of longitude in each polar hemisphere. The shape of the source-regions differs between the northern and the southern hemispheres. The source-regions exhibit growth and motion characteristics which suggest that their development is due partly to the effects of differential rotation. An analysis of the plage regions which are associated with source-flares shows that relatively few plages ever produce type II bursts, yet certain plages produce type II bursts repeatedly. One active region produced type II bursts on six consecutive disc passages. Since the source-regions for type II bursts are large-scale, persistent solar features that show motion and development related to the solar cycle, an evaluation of the distinctive fluid motion characteristics of these regions appears to be an im-

portant step in the determination of specific environmental configurations which can produce solar shock waves. (auth)

**12830** AN IMPULSIVE SOLAR X-RAY BURST IN THE ENERGY RANGE 90-400 keV. Fukada, Y.; Hayakawa, S.; Kasahara, I.; Makino. F.; Suzuki, I.; Tanaka, Y. (Nagoya Univ. (Japan). Dept. of Physics); Sreekantan, B. V. (Tata Inst. of Fundamental Research, Bombay (India)). Sol. Phys.; 42: No. 2, 441-444(Jun 1975).

A hard solar X-ray burst in the energy range 90-400 keV was observed at about 0528:30 UT on 13 April 1974. This event is peculiar in the sense that the X-ray flux is considerably high whereas the corresponding radio and optical flares are of moderate sizes, that the duration of the X-ray burst is very short, and that the X-ray peak is delayed by about 2.5 min relative to the first radio peak. (auth)

**12831** SLOW X-RAY BURSTS AND FLARES WITH FILAMENT DISRUPTION. Roy, J. R. (The Astronomical Institute at Utrecht, Space Research Laboratory, Ultrecht, The Netherlands); Tang, F. (Hale Observatories, Pasadena, Calif. (USA)). Sol. Phys.; 42: No. 2, 425-439(Jun 1975).

The data from OGO-5 and OSO-7 X-ray experiments have been compared with optical data from six chromospheric flares with filament disruption associated with slow thermal X-ray bursts. Filament activation accompanied by a slight X-ray enhancement precedes the first evidence of Hα flare by a few minutes. Rapid increase of the soft X-ray flux accompanies the phase of fastest expansion of the filament. Plateau or slow decay phases in the X-ray flux are associated with slowing and termination of filament expansion. The soft X-ray flux increases as $F \sim (A + Bh)$ h, where h is the height of the disrupted prominence at any given time and A and B are constants. It is suggested that the soft X-ray emission originates from a growing shell of roughly constant thickness of high-temperature plasma due to the compression of the coronal gas by the expanding prominence. (auth)

**12832** WHITE LIGHT FLARES: PROTONS OR ELECTRONS. Cortellessa, P.; Paizis, C. (Consiglio Nazionale delle Ricerche, Milan (Italy)). Sol. Phys.; 42: No. 2, 421-442(Jun 1975).

The estimated values of the energy transported by flare accelerated protons and electrons, based on γ-ray and hard X-ray measurements in space, are compared with the energy emitted in white light from the 1972, August 7, white light event. The aim is to evaluate the relative contribution of protons and electrons in producing the white light enhancement. (auth)

**12833** FLARE MODEL CHROMOSPHERES AND PHOTOSPHERES. Machado, M. E.; Linsky, J. L. (Joint Inst. for Lab. Astrophysics, Boulder, Colo. (USA)). Sol. Phys.; 42: No. 2, 395-420(Jun 1975).

Homogeneous plane-parallel model atmospheres for solar flares have been constructed to approximately simulate observations of flares. The wings of the Ca II lines have been used to derive flare upper photosphere models, which indicate temperature increases of ~100 K over the temperature distribution in the pre-existing facula at a height of 300 km above $\tau_{5000} = 1$. In the case of flares covering sunspots the temperature rise seems to occur much higher in the atmosphere. The transfer and statistical equilibrium equations are solved for a three-level hydrogen atom and a five-level calcium atom in order to obtain the chromospheric flare models. The general properties of flares, including $N_e$, $N_2$, linear thickness, and Lyman continuum intensity are approximately reproduced. It is found that with increasing flare importance the height of the upper chromosphere and transition region occur lower in the solar atmosphere, accounting for the factor of 60-600 increase in pressure in these regions relative to the quiet Sun. The Ca II line profiles agree with observations only by assuming a macro-velocity distribution that increases with height. Also the chromospheric parts of flares appear to be highly inhomogeneous. It is shown that shock and particle heated flare models do not agree with the observations and a thermal response model is proposed for flares. In particular, it appears that heating in the photosphere is an essential aspect of flares. (auth)

**12834** EVIDENCE FOR DOWNFLOW FOLLOWING A CORONAL TRANSIENT. Hildner, E. (High Altitude Observatory, Boulder, Colo. (USA)); Livingston, W. C. (Kitt Peak National Observatory, Tucson, Ariz. (USA)). Sol. Phys.; 42: No. 2, 391-394(Jun 1975).

On 11 September 1973 a peculiar prominence was observed. The prominence displayed strong (~50 km $s^{-1}$) systematic motions toward and away from the observer. The unusual spectrographic appearance of the prominence might have been due to downflowing material lifted into the corona during an earlier coronal transient. (auth)

**12835** ON THE NATURE OF SOME ACTIVE REGIONS IN THE MICROWAVE RANGE. Felli, M.; Tofani, G. (Osservatorio Astrofisico di Arcetri, Florence (Italy)); Fuerst, E. (Max-Planck-Institut fuer Radioastronomie, Bonn (F. R. Germany)); Hirth, W. (Bonn Univ. (F. R. Germany)). Sol. Phys.; 42: No. 2, 377-390(Jun 1975).

The radio emission of a selected number of solar active regions has been investigated with high angular resolution at two frequencies: 10 and 17 GHz. By comparing the results of the two observations the following conclusions can be drawn: The brightness temperature distribution of an active region is often composed of very bright cores of small dimension (angular extent $\theta \simeq 20''$) imbedded in extended halos of lower brightness. The radio emission of such structures as well as the degree of polarization can be explained with a thermal process. The halos can originate by pure thermal bremsstrahlung while in the case of the very bright cores found at 10 GHz (brightness temperature $Tb \simeq 1\text{-}9X10^6K$) the emission at the harmonics of the gyrofrequency is needed. (auth)

**12836** CRYSTAL SPECTROMETER STUDIES OF THE SUN EMPLOYING A ROTATION MODULATION COLLIMATOR. Brabban, D. H.; Glencross, W. M.; Rosenberg, F. D. (Mullard Space Science Lab., Dorking (UK)). Sol. Phys.; 42: No. 2, 355-376 (Jun 1975).

The use of rotating modulation collimators in high resolution solar X-ray spectroscopy is discussed with reference to the recent flight of a sounding rocket payload. This rocket carried an experiment which combined a modulation collimator and a Bragg crystal spectrometer to make moderately high resolution spectral and spatial measurements simultaneously. The response of the instrument to extended sources is described. It is shown that the technique is particularly suited to long term observations of active region emission, but that useful measurements can be made even during a short rocket flight. The observations were made in October 26, 1972, between 04 32 UT and 04 36 UT. During the flight a scan of the solar X-ray spectrum was made which covered the wavelength range 1.45-1.71 nm. A small flare commenced at about 04 32 UT in McMath calcium plage region 12094; the emission from this provided the major contribution to the observed spectrum. X-ray emission from a group of active regions in the SW and the small McMath region 12090 has also been detected. Spectral and spatial observations have been combined to investigate the conditions in both active region and flare plasmas. (auth)

**12837** PRECISE DETERMINATION OF THE ORIENTATION OF THE PLANE OF POLARIZATION IN THE SOLAR CORONA. Kishonkov, A. K.; Molodensky, M. M. (AN SSSR, Moscow. Inst. Zemnogo Magnetizma, Ionosfery i Rasprostraneniya Radiovoln). Sol. Phys.; 42: No. 2, 341-353(Jun 1975).

It has been shown by Molodensky (1973), that precise measurements of the position of the plane of polarization in the corona may allow overthermal electrons in the solar corona to be observed. For such measurements during the eclipse of July 10, 1972, a method based on the photographic recordings of the corona by means of a cineset and with an automatically rotating polaroid has been developed. A technique has also been developed for determining the position of the plane of polarization by means of isophotes obtained with polarization filters. This technique uses the photometric data for determining phase shifts between the apparent intensity variation curve and a similar curve expressing the rotation phase of the polaroid. The results of the measurements for $h/R_\odot = 0.5$ to 0.9 give the following conclusions: The plane of polarization (E-vector position) coincides very exactly with the tangential direction in the region of N-W limb. The maximum deviations of this plane amounts to 1-1.5°, and the mean-square deviations in this region amount of ~0.3° at $h/R_\odot$ ~1. This coronal region was the least active one and there were no spots there. The corona near the E limb consisted of two "fans" divided by a thin beam. In that region some deviations of the plane of polarization from the tangential direction were revealed. Those deviations were of the order of 3°. During the time of the eclipse there were some groups of spots behind the E limb (but close to this limb). The observed deviations were apparently connected with those groups. Calculations have been made of the turn of the plane of polarization caused by an inhomogeneity in the radiation field from the photosphere and due to the presence of spots. The effect qualitatively coincided with that shown by the measurements. (auth)

**12838** ALFVEN WAVES AND THE SUNSPOT PHENOMENON. Wilson, P. R. (Sydney Univ. (Australia). Dept. of Applied Mathematics). Sol. Phys.; 42: No. 2, 333-340(Jun 1975).

Parker's explanation of the sunspot phenomenon in terms of the enhanced emission of Alfvén waves (solar vulcanology) is shown to be compatible with observation only if ~90% of the waves propagate downwards. Further difficulties arise if the region of cooling by Alfvén wave generation is restricted to a depth of 2 Mm. However, it is shown that, if Alfvén wave generation is in-

cluded in a recent model proposed by Meyer, Schmidt, Weiss and Wilson, these difficulties may be resolved. The problem of the sharp umbra and penumbra boundaries is discussed and it is shown that features of this combined model are relevant to the flare phenomenon. (auth)

**12839** SUNSPOT AND STRAY LIGHT OBSERVATIONS DURING THE 1971, FEBRUARY 25 PARTIAL SOLAR ECLIPSE. Koeppen, J. (Fraunhofer Institut, Freiburg i. Br., F. R. Germany). Sol. Phys.; 42: No. 2, 325-332(Jun 1975).

Observations of a sunspot during and after a partial solar eclipse are described. The amount of scattered light confirms the existence of a spread function component with a half width of 10''. The observations also indicate the possibility of severely underestimating this component by aureole measurements. Umbral continuum intensities of 0.10 $I_{\odot}$ in the red spectral region were directly measured, the correction for scattered light amounts to 0.02 $I_{\odot}$. Intensities calculated with four umbral models are larger than the observed values, indicating this sunspot to be cooler by some 100 K. The wings of two strong Ca I lines are equally explained by the models of Henoux, Kneer, and Stellmacher/Wiehr. Yun's model can be ruled out because of too high a temperature. (auth)

**12840** CHROMOSPHERIC BUBBLES. Mouradian, Z.; Simon, G. (Observatoire de Paris, Section de Neudon, 92 (France)). Sol. Phys.; 42: No. 2, 311-323(Jun 1975). (In French)

The purpose of this work is to study some characteristics of roundish features which are observed on H$\alpha$ filtergrams, above the solar chromosphere, at the limb. The "Bulles"—chromospheric bubbles—so called for their apparent shape, move upwards into the low corona and fade out when their material is completely ionized. The physical data listed for nine observed bubbles are: lifetime, average height, ascending velocity, lateral velocity, angle of the movement with the normal to the solar limb, intensity in H$\alpha$ and diameters. The time variations of some of these properties are pictured. It is noted that all measured velocities are super-sonic. The relation between the ascending velocity and the maximum height reached by the bubbles is discussed and compared with the one obtained by Rush and Roberts for spicules. The study of their diameters shows that the vertical diameter is generally greater than the horizontal one. Their ratio is a function of speed and becomes equal to unity when the bubble velocity reaches 70 km $s^{-1}$. The bubbles seem to diffuse in the corona as spicules do. The properties of bubbles are also compared with some already known chromospheric features and there seems to be a link between bubbles and Becker's grains. Finally, however, two hypotheses are proposed regarding the origin of bubbles: (i) they are related to spicules, or (ii) they are accelerated in the low chromosphere by the divergence of the magnetic field. (auth)

**12841** SPECTRAL INVESTIGATION OF THE CHROMOSPHERE. V. Observation and Analysis of H$\beta$. Grossmann-Doerth, U.; Uexkuell, M. V. (Fraunhofer Institut, Freiburg, F. R. Germany). Sol. Phys.; 42: No. 2, 303-309(Jun 1975).

The results of the analysis of 16 H$\beta$ spectra taken with high spatial resolution are presented. The properties of the line profile in the boundary regions of supergranular cells (SGB) are described by the statistical distribution functions and correlation coefficients of four parameters which determine the shape of a suitable fitting curve. Although some of the line profile properties of both H$\beta$ and H$\alpha$ in the SGB can be interpreted in terms of a model which was recently proposed by Durrant (1975) the agreement between that theory and the observations is not entirely satisfactory. (auth)

**12842** THE FORMATION OF Mg I 4571 A IN THE SOLAR ATMOSPHERE. V. The Multi-dimensional Structure of the Photosphere and Low Chromosphere. Altrock, R. C. (Sacramento Peak Observatory, Air Force Cambridge Research Labs., Sunspot, N. M., U.S.A.); Cannon, C. J. (Centre National de la Recherche Scientifique, 75-Paris (France). Inst. d'Astrophysique). Sol. Phys.; 42: No. 2, 289-302(Jun 1975).

The two dimensional equation of transfer is solved for the case of locally-controlled source function (LTE) and radiationally-controlled ionization. Horizontal fluctuations in electron temperature and macroscopic velocity fields are superposed on the basic one-dimensional model (cf. Altrock and Cannon, 1972). Output intensities are compared with observed rms intensity fluctuations and spatially-averaged intensities in Mg 1 4571 Å. It is found that at least one model (with a height-independent temperature fluctuation $\Delta T/T = \pm 0.02$ in the range $0 \leq h \leq 450$ km) can predict the magnitude of the intensity fluctuations in both the continuum and λ4571 Å. The asymmetry of the line can be explained by adding a height-independent, temperature-correlated flow of amplitude 1 to 2 km $s^{-1}$. The relationship between these results and other multi-dimensional analyses is discussed. (auth)

**12843** TEMPERATURE VARIATION WITH LATITUDE IN THE UPPER SOLAR PHOTOSPHERE: RELEVANCE TO SOLAR OBLATENESS MEASUREMENTS AND FACULAR MODELS. Ingersoll, A. P. (California Inst. of Tech., Pasadena (USA). Div. of Geological Sciences); Chapman, G. A. (San Fernando Observatory, Space Physics Laboratory, The Aerospace Corporation, U. S. A.). Sol. Phys.; 42: No. 2, 279-288(Jun 1975).

Altrock and Canfield's observations of temperature variation with latitude in the upper solar photosphere refer to higher levels (smaller optical depths) than those to which Dicke and Goldenberg's solar oblateness observations refer. These higher levels account for only 1% of Dicke and Goldenberg's observed intensity. Thus Altrock and Canfield's observations are not inconsistent with models which have been proposed to account for solar oblateness observations by means of a brightness variation with solar latitude. (auth)

**12844** PLANETARY TIDES AND SUNSPOT CYCLES. Condon, J. J.; Schmidt, R. R. (Virginia Polytechnic Inst. and State Univ., Blacksburg (USA)). Sol. Phys.; 42: No. 2, 529-532(Jun 1975).

There is an empirical function of the heights of tides on the Sun produced by Venus, Earth, and Jupiter whose period is nearly equal to that of the 11-yr sunspot cycle (Wood, 1972). This period match has been used in suggestions that planetary tides cause sunspots and, indirectly, terrestrial climate changes and earthquakes. The period of the tidal function is derived in terms of the planetary orbital periods and it is shown that it is artificially lengthened by aliasing. Furthermore, there exists a class of functions whose measure in frequency space is so great that, in the absence of a physical justification for preferring one member, no statistically significant period match can possibly be made with current sunspot data. (auth)

**12845** EVALUATION OF THE SOLAR LIMB SCINTILLATION SPECTRUM BY THE VARIABLE-APERTURE METHOD. Kasinskii, V. V. pp 103-110 of Atmospheric Optics. Moscow; Izdatel'stvo Nauka (1974). (In Russian)

The behavior of the scintillations of the focal plane of a telescope is analyzed, treating the lense as a linear filter of the spatial frequencies of the distorted wave front. The filter suppresses discontinuities whose dimensions are smaller than the lense diameter and transmits deformations of the lense diameter. The contribution of the individual components to the total wave front deformation spectrum is evaluated by successively decreasing the aperture and measuring the scintillations. (IAA)

**12846** WAVE-TRAINS IN THE SOLAR WIND. III. Alfven Waves in the Azimuthally-Dependent Interplanetary Medium. Richter, A. K. (Kiel Univ. (F. R. Germany). Inst. fuer Reine und Angewandte Kernphysik). Astrophys. Space Sci.; 36: No. 2, 383-405(Sep 1975).

Applying an Alfven-Wave-Extended-QRH-approximation and the method of characteristics, the equations of motion for outwardly propagating Alfven waves are solved analytically for three different cases of an azimuthal dependence of the background solar wind, (a) for a pure fast-slow stream configuration, (b) for the situation where the high-speed stream originates from a diverging magnetic field, and (c) for the case of (b) and an initially decreasing density configuration ("coronal hole"). The reaction of these waves on the background state as well as mode-mode coupling effects are neglected. These three solar wind models are discussed shortly. For the superimposed Alfven waves it is found, on an average, that there is a strong azimuthal dependence of all relevant parameters which, correlated with the azimuthal distributions of the solar wind variables, leads to good agreements with observations. The signature of high-speed streams and these correlations could clearly indicate solar wind streams originating from "coronal holes." Contrary to the purely radial solar wind, where outwardly propagating Alfven waves are exclusively refracted towards the radial direction, a refraction nearly perpendicular to the direction of the interplanetary magnetic field in the compression region and closely towards the magnetic field direction down the trailing edge and in the low-speed regime is found. (NL)

**12847** SOLAR-WIND INDUCTION AND LUNAR CONDUCTIVITY. Sonett, C. P. (Arizona Univ., Tucson (USA)). Phys. Earth Planet. Inter.; 10: No. 3, 313-322(Jul 1975).

From 2nd workshop on electromagnetic induction in the earth; Ottawa, Canada (22 Aug 1974).

A summary review of electromagnetic induction driven in the Moon by the interplanetary magnetic field is given. The point of view developed centers on inversion of Fourier transforms of the magnetic field in the free-stream solar wind (forcing function) and the response on the lunar surface measured by Lunar Surface Magnetometers. Conductivity profiles are shown to depend upon the central angle between the magnetometer given by

local time and the incident wave normal direction. The induction excites at least magnetic dipole and quadrupole radiation but any scattered field is confined to the Moon's interior, save for propagation down the cavity where a TE-mode surface wave is generated. Confinement of the induced field on the sunward hemisphere and near the subsolar point is nearly complete, decreasing to the limbs, while in the diamagnetic cavity downstream of the Moon partial confinement takes place. Both time and spatial multipoles of the induced field are present in the lunar interior complicating inversion into conductivity profiles. Profiles and resolution limits are given and compared to those obtained from transient analysis. Finally a qualitative comparison to conductivity in the Earth is given. (NL)

**12848** JUPITER'S BOW SHOCK: COMPARISON WITH THEORY. Dryer, M. (Space Environment Lab., Boulder, CO). pp 475-477 of Solar Wind Three. Russell, C. T. (ed.). Los Angeles; Univ. of California (1974).

From 3rd conference on solar wind three; Pacific Grove, CA, USA (25 Mar 1974).

**12849** SOLAR PROTON EVENTS: STRATOSPHERIC SOURCES OF NITRIC OXIDE. Crutzen, P. J.; Isaksen, I. S. A.; Reid, G. C. (National Oceanic and Atmospheric Administration, Boulder, CO). Science; 189: No. 4201, 457-459(8 Aug 1975).

The production of nitric oxide (NO) in the stratosphere during each of the solar proton events of November 1960, September 1966, and August 1972 is calculated to have been comparable to or larger than the total average annual production of NO by the action of galactic cosmic rays. It is therefore very important to consider the effect of solar proton events on the temporal and spatial distribution of ozone in the stratosphere. A study of ozone distribution after such events may be particularly important for validating photochemical-diffusion models. (auth)

## Galaxies

*Refer also to abstracts 12111, 12768, 12779, 12786, and 13325.*

**12850** (N-75-15456) EFFECT OF SUPRATHERMAL PROTONS ON THE PHYSICAL CONDITIONS IN SEYFERT GALAXY NUCLEI. Ptak, R.; Stoner, R. (Bowling Green State Univ., Ohio (USA). Dept of Physics). 1974. 27p. (NASA-CR-141307). NTIS $3.75.

The physical conditions in a high density hydrogen gas heated and ionized by suprathermal protons were investigated, with application to the gas in the nuclear region of Seyfert galaxies. The gas is assumed optically thick to Lyman and Balmer line radiation. Mechanisms by which the radiation from the gas can balance the heating by the fast protons were investigated, and minimum values for the mass of gas were estimated. Under certain conditions, the suprathermal atoms themselves can cool the ambient gas by rescattering the line radiation into the optically thin region in the wings of the line. This mechanism, called optical reverberation, can enhance the broad component of the hydrogen lines produced by inelastic atomic collisions and yield line widths consistent with those observed in Seyfert and quasar spectra. Also discussed is the possibility of achieving dynamic equilibrium of the ambient gas by balancing the momentum transfer from the suprathermals with gravitational attraction of a massive central source. (auth)

**12851** (N-75-15516) TIME DEPENDENT EMISSION LINE PROFILES IN THE RADIALLY STREAMING PARTICLE MODEL OF SEYFERT GALAXY NUCLEI AND QUASI-STELLAR OBJECTS. Hubbard, R. (Bowling Green State Univ., Ohio (USA). Dept of Physics). 1974. 20p. (NASA-CR-141299). NTIS $3.25.

The radially-streaming particle model for broad quasar and Seyfert galaxy emission features is modified to include sources of time dependence. The results are suggestive of reported observations of multiple components, variability, and transient features in the wings of Seyfert and quasi-stellar emission lines. (auth)

**12852** SPIRAL GALAXY DYNAMICS. Weliachew, L. (Observatoire de Paris, Section de Meudon, 92 (France)). Recherche (Paris); 6: No. 55, 319-327(Apr 1975). (In French)

About half of the galaxies offers spiral shapes that remained unexplained for a long time. The problem of their origin remains unsolved but explanations are now given for such shapes to exist and to be maintained. Till now no contradiction with observation might infer the ruin of the theories built but the critical time occurs where new observations may confirm or cancel the various theoretical predictions. (FR)

**12853** PROJECTION OF Sc GALAXIES AND QSS ON SUPERGALACTIC COORDINATES. Karoji, H. (Paris-6 Univ., 75 (France). Inst. Henri Poincare). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 14, 455-457(14 Apr 1975). (In French)

Spiral galaxies and QSS's are plotted on the supergalactic planes Y-Z, X-Y of de Vaucouleurs' system. As seen on the histograms, spirals and local QSS's are distributed in the space, in nearly the same manner. (FR)

**12854** THE RADIO SPECTRUM OF THE ORION NEBULA. Goudis, C. (Manchester Univ. (UK)). Astrophys. Space Sci.; 36: No. 1, 105-109(Aug 1975).

The radio spectrum of the Orion A (combined spectrum of both the M42 and M43 sources) is established by using more data than previous authors. The frequency range is also substantially expanded by using recent results. A peculiar feature appearing in the produced radio spectrum is discussed. (auth)

**12855** A CLASSIFICATION OF THE AVAILABLE ASTROPHYSICAL DATA OF PARTICULAR HII REGIONS. II. Orion Nebula: Physical Parameters. Goudis, C. (Manchester Univ. (UK)). Astrophys. Space Sci.; 36: No. 1, 79-104(Aug 1975).

The physical parameters of the object compiled from various authors are classified in a separate table. Line ratios are presented for their significance in determining the density and temperature of the nebula. Data for the electron temperature of the object are also presented. A correlation of several interesting features of the core of the nebular complex is also shown. (auth)

**12856** EXISTENCE AND THE DENSITY OF INTERGALACTIC DUST. Schmidt, H. J. (Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Astrophysik). Astron. Nachr.; 295: No. 4, 163-168(1974).

A relation between the redshift z of QSO's and their color index $(B-V)'$ corrected for line emission and galactic absorption is interpreted in terms of an intergalactic extensive extinction. The observed amount of extinction corresponds to a density of intergalactic dust grains of about $10^{-34}$ to $10^{-33}$ g cm$^{-3}$ at $z = 0$. The lifetime of these particles is estimated to be longer than the HUBBLE time at present. But at large z the lifetime of the grains considerably depends on the flux density of cosmic rays. Some implications of the existence of intergalactic dust are discussed. (auth)

**12857** ORIGIN OF THE DIFFUSE INTERSTELLAR ABSORPTION BANDS. I. The Structure of Interstellar Grains. Duley, W. W. (York Univ., Toronto, Ontario (Canada). Center for Research in Experimental Space Science). Astrophys. Space Sci.; 36: No. 2, 345-351(Sep 1975).

The influence of crystal structure and surface stresses on the spectrum of small interstellar particles has been investigated. Surface effects are predicted to result in the occurrence of pairs of features in the discrete absorption spectrum of interstellar dust. A simple relationship between the energy separation between lines of these pairs and their widths is derived which is tested against recent observational data on the diffuse interstellar band spectrum. Thirty of the diffuse bands can be accounte for on this basis by assuming that interstellar dust consists of a mixture of components of differing chemical compositions. (NL)

**12858** POPULATION OF EXCITED ROTATIONAL LEVELS OF INTERSTELLAR $H_2$. Joshi, P. (Tata Inst. of Fundamental Research, Bombay (India)); Tarafdar, S. P. (University Coll. of South Wales and Monmouthshire, Cardiff (UK)). Astrophys. Space Sci.; 36: No. 2, 281-289(Sep 1975).

The population of the rotational levels of vibrational and electronic ground state of interstellar $H_2$ has been calculated; differen possible excitation and de-excitation mechanisms including the ultraviolet pumping and formation and destruction of molecules have been considered. The values of temperature, density and radiation field towards $\zeta$ Oph, $\epsilon$ Per and $\zeta$ Pup have been obtained by comparing the theoretical distributions with the observations. The results indicate the presence of a high temperature low density diffuse cloud towards $\zeta$ Pup and low temperature high density clouds towards $\zeta$ Oph and $\epsilon$ Per. The results of this work were presented at the February, 1974, meeting of the Astronomical Society of India (Joshi and Tarafdar, 1974). (NL)

**12859** POPULATION OF EXCITED ROTATIONAL LEVELS OF HD AND CO IN INTERSTELLAR CLOUDS. Joshi, P. (Tata Inst. of Fundamental Research, Bombay (India)); Tarafdar, S. P. (University Coll. of South Wales and Monmouthshire, Cardiff (UK)). Astrophys. Space Sci.; 36: No. 2, 291-301(Sep 1975).

Populations of the rotational levels of vibrational electronic ground state of interstellar HD and CO have been calculated. Ultraviolet pumping and molecular formation have been found to be very important in the case of HD but not so in CO, the population distribution of which is mainly governed either by 3 K or by collisional excitation. The population inversion has been found to occur in HD but not in CO, the excitation temperatures of which pass through maximum for large ultraviolet flux. The population inversion at large density does not occur in HD, probably due to neglect of multipole collision. The observation of HD and CO in the excited states may be possible for suitable values of density and ultraviolet flux. (NL)

# Cosmology

*Refer also to abstracts 12795, 13878, and 13881.*

**12860** QUANTUM THEORY OF SIMPLE ALTERNATIVES. Castell, L. (Max-Planck-Institut, Starnberg, Ger.). pp 147-161 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).

From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.

Starting from the concept of time and a simple yes-no alternative (ur-object) with its invariance group, it is shown how one arrives at a (flat-space) twistor, which has the properties of a doubled simple alternative. The quantization of this basic physical object leads to a neutrino, which can be interpreted as a bound state of simple alternatives. The relative position of ur and anti-ur determines the space-time manifold. The Riemannian metric of this cosmological model is determined by the original symmetry group U(2). The local limit leads to Minkowski space, position operators, discrete mass representations, and redshift. (auth)

**12861** VARIANT OF SPECIAL RELATIVITY AND EXTRAGALACTIC ASTRONOMY. Segal, I. E. (Massachusetts Inst. of Tech., Cambridge). pp 163-212 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).

From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.

The treatment of a variant of special relativity and extragalactic astronomy covers the cosmos and causality, the cosmos and symmetry, and the universal cosmos in perspective. (JFP)

**12862** QUANTUM COSMOLOGY. Brill, D. R. (Univ. of Maryland, College Park). pp 231-246 of Quantum Theory and the Structures of Time and Space. Castel, L. (ed.). Munich; Carl Hanser Verlag (1975).

From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.

The consideration of quantum cosmology includes some physical effects and a simple model of quantum cosmology. The Friedman model, Hamiltonian quantization, quantization by reduction, and different views of the singularity are covered. (JFP)

**12863** GRAVITATIONAL-RADIATION EXPERIMENTS. Pizzella, G. (Univ., Rome). Riv. Nuovo Cim.; 5: No. 3, 369-397(1975).

The review of gravitational-radiation experiments includes the general relativity background, gravitational waves as a solution of the Einstein equation, the mechanism of the generation of gravitational waves, energy flux carried by gravitational waves, interaction of gravitational waves with a two-point mass system and with a cylindrical antenna, thermal noise, and antenna sensitivity. (JFP)

**12864** RECENT DEVELOPMENTS IN ANTIMATTER COSMOLOGY. Omnes, R.; Caser, S. pp 225-233 of Ondes et Radiations Gravitationnelles. Paris; Centre National de la Recherche Scientifique (1974). (In French).

From international colloqium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The possible existence of antimatter on a cosmic scale is discussed. The condition of nucleon-antinucleon separation according to general relativity in an isotropic universe are analyzed, after which coalescence, i.e., the induction of fluid movements in the emulsion at the matter-antimatter boundary by annihilation, is examined. This leads to the origin of the galaxies and could explain the excess of high energy cosmic photons revealed experimentally. (FR)

**12865** GRAVITATIONAL WAVE DETECTION EXPERIMENT IN FRASCATI. Maischberger, K. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). pp 171-180 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The Frascati detector is a copy of the Weber (USA) instrument, with a signal/noise ratio improved by a factor 2.5. Computerized data analyses allow a study of the amplitude and phase of the signal. It is observed that vibrations of energy 0.25kT were never detected more than once a day, which leads to the logical conclusion that Weber's claim can only be taken into consideration if his equipment is capable of detecting vibrations below 0.1kT. (FR)

**12866** EVALUATION OF THE MUNICH–FRASCATI WERBER-TYPE EXPERIMENT. Kafka, P. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). pp 181-201 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The theory of optimal evaluation is sketched and applied to the case of short pulses of gravitational radiation. The concepts of one-detector and multi-detector sensitivity are classified. Comparison of the equivalent circuits of various detectors and tests with artificial pulses show that the pulses reported by Weber should be detectable in coincidence between Munich and Frascati. First negative results are presented. (ER)

**12867** LIMITS ON TERRESTRIAL PRODUCED GRAVITATIONAL RADIATION. Halpern, L. (Brussels Univ. (Belgium)). pp 373-378 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The gravitational radiation emission of a certain system of electromagnetic waves of a cavity is calculated in the linear approximation. The emitter is considered the most efficient possible apart from a gravitational laser and allows the maximum fluxes attainable by terrestrial sources to be estimated. (FR)

**12868** EXPERIMENTS AND OBSERVATIONS WITH WIDE BAND GRAVITY WAVE DETECTORS. Drever, R. W. P.; Hough, J.; Bland, R.; Lessnoff, G. W. (Glasgow Univ. (UK). Dept. of Natural Philosophy). pp 113-133 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The wide band-pass gravitational wave detectors built at the Faculty of Glasgow are described. The results of six months' observation are reported. (FR)

**12869** SOURCES AND ASTROPHYSICAL EFFECTS OF GRAVITATIONAL WAVES. Rees, M. J. (Cambridge Univ. (UK)). pp 203-212 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The probable sources of short intense gravitational wave emissions are discussed, and it is concluded, on the basis of current astrophysical ideas, that the number of events detected by an apparatus such as Weber's would not be more than one pulse per century. Some proposed explanations of a higher event rate are examined briefly but it is suggested that the sensitivity would probably have to be improved by a factor $10^3$ if a few events per year due to extragalactic supernovae are to be detectable. Several other kinds of gravitational waves of potential interest in astrophysics are mentioned. (FR)

**12870** MATCHING CONDITIONS IN THE DESIGN OF GRAVITATIONAL DETECTOR SYSTEMS. Maeder, D. G. pp 359-363 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The problem of optimization is reduced to an equilibrium between two partial signal/noise ratios, one (mechanical) is proportional to $n^{-\frac{1}{4}}$, the other (electrical) is proportional to $n^{\frac{1}{4}}$ where n = resolution time in detector resonance half-period multiples. Respecting two adaptation conditions while varying $\mu$(= relative transducing mass) it is found that the optimum resolution time $n^*$ is proportional to $1/\mu$ whereas the corresponding sensitivity depends very little on $\mu$. (FR)

**12871** PROPOSED STANDARDIZATION OF GRAVITATIONAL BURST DETECTOR SIGNALS. Maeder, D. G. pp 365-369 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The response of detectors of different mass, length, etc. subjected to the same gravitational perturbation is compared with that caused by a hypothetical pulse of $J = \int_{t_0}^{t_0} dt$ different of 0. The correction between J and the area below the largest semi-undulation of $R_{t_0 t_0}(t)$ is calculated as a function of x (frequency of the Fourier spectrum maximum/resonance frequency of the detector) and of the number of undulations. The energy of an event of total duration D becomes $J^2 d$. (FR)

**12872** LOW TEMPERATURE GRAVITATIONAL RADIATION ANTENNA. A Progress Report. Carelli, P.; Cerdonio, M.;

Giovanardi, U.; Lucano, G.; Modena, I. pp 257-264 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

Low temperature antennas for gravitational waves detection are being developed at Stanford, Baton Rouge, and Rome. Their general features are similar and are described together with the design of a new deformation detector under development in Rome. The general situation of the Rome project is reported, with results on the magnetic suspension system. The minimum gravitational wave flux detectable in the particular apparatus is discussed. (FR)

**12873** ISSUES IN GRAVITATIONAL WAVE DETECTION WITH SPACE MISSIONS. Davies, R. W. (Jet Propulsion Lab., Pasadena, Calif. (USA)). pp 33-45 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

Two masses gravitating freely in the solar system and separated by several astronomical units can be used as antennae for the detection of monochromatic gravitational radiations emitted by double stars. If one of these masses is an artificial satellite the relative acceleration can be measured by employing the Doppler effect of the radio signal from the satellite. For this purpose the standard clock should be stable to within $10^{-13}$. (FR)

**12874** NON-SINGULAR HOMOGENEOUS UNIVERSES WITH FOUR-PARAMETER LIE GROUPS. Kuchowicz, B. (Warsaw Univ. (Poland)). Phys. Lett., A; 54: No. 1, 13-14(11 Aug 1975).

It is proved, within the framework of the Einstein-Cartan theory that singularities may be prevented in homogeneous cosmological models which do not permit any simply transitive group of motions. An oscillating universe with a minimum non-zero radius is possible. (auth)

**12875** STEADY STATE DISTRIBUTION OF AN IDEAL CLUSTER OF GALAXIES FOR NEGATIVE COSMOLOGICAL CONSTANTS. Chen, M. C. (California State Univ., Fullerton (USA)); Sachdev, S. K. (Arizona Univ., Tucson (USA)). Astron. Nachr.; 296: No. 1, 19-24(1975).

The space distribution of an ideal cluster of galaxies in the steady state for various negative cosmological constants is solved numerically. The galaxy members in the ideal cluster are considered point objects with equal masses. This is an extension of the classical LANE-EMDEN isothermal sphere to negative cosmological constant. (auth)

**12876** FINAL STATES OF CONTINUOUSLY EXPANDING UNIVERSE. Treder, H. J. (Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Astrophysik). Astron. Nachr.; 295: No. 1, 9-10(1974).

The relativistic expanding universes with negative curvatures $k < 0$ and $\lambda = 0$ or with positive cosmological constant $\lambda > 0$ becomes for $t \to \infty$, $R \to \infty$ empty space-times, asymptotically. This empty space-time is for $k < 0$, $\lambda = 0$ the Minkowski world and for $\lambda > 0$ a de Sitter world. (auth)

**12877** GENERAL METRICAL FUNDAMENTAL FORM OF THE de SITTER UNIVERSES. Treder, H. J. (Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Astrophysik). Astron. Nachr.; 296: No. 1, 15-18(1975).

The general metrical fundamental form of a de Sitter universe depends on two integration constants A and B. With Einstein's cosmological constants $\lambda > 0$ one has $R(t) = Ae^{\sqrt{\lambda/3}t} + Be^{-\sqrt{\lambda/3}t}$ and $\epsilon = 4\lambda/3$ AB according to the Friedmann equation. (GC)

**12878** WAVE-WAVE INTERACTIONS AND GRAVITATIONAL INSTABILITY. Hruska, A. (National Research Council of Canada, Ottawa, Ontario. Div. of Physics). Astrophys. Space Sci.; 36: No. 2, 451-454(Sep 1975).

The instability of gravitational waves with $k > k_{Jeans}$ in a weakly turbulent gas is discussed. Basic features of processes leading to amplification or damping of gravitational waves are described. Growth rates of the amplitudes are calculated. (NL)

**12879** EMPTY HORIZONS IN COSMOLOGICAL MODELS. King, A. R. (Hamburg Univ. (F. R. Germany). 1. Inst. fuer Theoretische Physik). Phys. Lett., A; 54: No. 2, 115-116(25 Aug 1975).

The possibility that the matter density might become zero in certain regions of cosmological models is studied. It is shown that this can only occur in a non-singular way if the horizon is "at infinity." (NL)

**12880** THE FORCE-FIELD APPROACH TO NEUTRON MONITOR OBSERVATIONS OF THE ELEVEN-YEAR COSMIC-RAY MODULATION CYCLE. Moraal, H. (1973). 130p. INIS.

A method is developed to describe the eleven-year cosmic-ray modulation cycle as observed by neutron monitors, in terms of the force-field approximation of the modulation model. This approximation takes into account energy charges of cosmic-ray particles during the modulation process. Modulation studies on neutron monitor observations have thus far been conducted only in the convection-diffusion and modified convection-diffusion approximations, which do not properly account for energy changes. The cosmic-ray equations of transport are developed from the literature, and the essence of some solutions are indicated. The force-field solution is then applied to three response functions, calculated from latitude surveys with an airborne neutron monitor. Subsequently, observations on stationary neutron monitors are interpreted in terms of the force-field solution. It is found that hysteresis effects, steplike modulation changes and double intensity minima can be explained in terms of changes of two modulation parameters which change over the solar cycle. Finally, the validity of the force-field approximation and the spherical symmetric modulation model are tested and discussed, and it is concluded that the force-field approximation is adequate to describe modulation changes at rigidities $\gtrsim 1$ GV. It is noted however that the spherical symmetric modulation model may be an oversimplification of the actual situation. (auth)

## Planetary Phenomena

*Refer also to abstracts 12802, 12844, 12847, and 13902.*

**12881** (KURRI-TR-122, pp 20-24) RESIDUAL TRACKS AND SUPERHEAVY NUCLEI IN METEORITES. Nakanishi, T. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

The residual tracks observed in meteorites are mostly the fission tracks of uranium and plutonium or the tracks of heavy cosmic rays. Since the length of tracks depends on the nuclear charge, mass number and energy of particles, it is possible to estimate superheavy nuclei in meteorites from the length of tracks. H. W. Schmitt et al. estimated the relation between the mass number of fissile nuclei and the total kinetic energy of fission products. The total energy of fission products in superheavy nuclei domain is larger than that of uranium or plutonium by 20%. Then, the tracks of fission products of superheavy nuclei will be identified. At this moment, it is impossible to prove this prediction experimentally, therefore an empirical law obtained for $^{252}$Cf, $^{235}$U and $^{239}$Pu is extended to check the possibility. The law estimates the length of tracks of F. P. of superheavy nuclei as 18 $\mu$m, while that of U as 15 $\mu$m. This difference between the track length can be detected by the present experimental technique. The experimentally observed track length is usually shorter than that estimated theoretically, and the length is predicted as 16-22 $\mu$m in the case of $_{114}$Sh. Other causes than superheavy nuclei which make longer tracks than those of F. P. of U are examined. People of Tata Laboratory, India, reported that they observed long tracks due to superheavy nuclei in meteorite by the TINT method and the TINCLE method. The present author also detected the same tracks in the Norton County meteorite as those observed by the Tata group. (JA)

**12882** (KURRI-TR-122, pp 30-42) POSSIBILITY OF EXISTENCE OF SUPERHEAVY ELEMENTS IN COSMIC MATERIALS (METEORITE). Sakamoto, K. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

The composition of Xe isotopes in meteorites has been studied and theories concerning the obtained results are presented. The anomaly in spectra for $Xe^{131-136}$ is called general anomaly. Anders, Rao and Dakowski proposed that the origin was superheavy elements. The correlation of the amount of $^{132}$Xe, which shows good correlation with volatile material, with the amount of $^{136}$Xe was shown by Anders and Heyman. They thought that $^{136}$Xe was produced by volatile and spontaneously fissile material such as elements with Z = 111 - 119. The half-life of parent nuclei was estimated. The thermodynamical properties were suggested from the consideration of accumulating and solidifying process of elements from nebula. Rao and Dakowski derived mass distribution in the spontaneous fission of superheavy nuclei from the spectra of carbonaceous chondrite fission Xenon (CCFXe). The author criticizes these theories. The method to identify CCFXe is not complete at present. Some doubt remains in the estimation of the half-life of parent nuclei. The theory of mass identification is still ambiguous. (JA)

**12883** OUT-OF-ECLIPTIC DUST. Giese, R. H. (Bochum Univ. (F. R. Germany)). ELDO/ESRO Sci. Tech. Rev.; 7: No. 1, 43-51(1975).

Predictions of the number density of interplanetary dust particles out of the ecliptic plane are derived from model computations by adjusting the parameters to the run of brightness of the zodiacal light in the ecliptic plane and at right angles to the Sun from the ecliptic plane to the ecliptic pole. Within the limits of the simple models, surfaces of equal number density are presented. The number density of zodiacal dust particles is not expected to fall below 20% within 0.5 AU above the earth's orbit. The use of space probes in and out of the ecliptic is discussed, and the possibility of discriminating between different dust distribution functions by means of out-of-ecliptic probes is demonstrated for a space probe in an orbit of 1 AU radius and 30 deg inclination with respect to the ecliptic plane. (FR)

**12884** ON POSSIBLE SHORT-LIVED PROGENITORS OF FISSION XENON IN CARBONACEOUS CHONDRITES. Howard, W. M.; Arnould, M.; Truran, J. W. (Illinois Univ., Urbana (USA)). Astrophys. Space Sci.; 36: No. 1, L1-L9(Aug 1975).

It is suggested that the unidentified fission xenon component in carbonaceous chondrites may be attributable to the decay of the extinct radioactivities $^{250}$Cm and, to a lesser extent, $^{248}$Cm. Two assumptions are fundamental to this picutre: these relatively short-lived actinides ($1.13 \times 10^4$ and $3.7 \times 10^5$ yr, respectively) were incorporated into grains in the vicinity of their supernova birthplace (prior to decay); and such grains and their trapped anomalous xenon component were incorporated intact into the meteorites. Recognizing the many substantial uncertainties associated with our suggested model, the importance of precise experimental determinations of the mass spectra of fission xenon resulting from $^{250}$Cm and $^{248}$Cm decay is emphasized. (auth)

**12885** FRAGMENTATION OF ASTEROIDS: A SYNOPSIS OF ANALYTICAL METHODS. Dorschner, J. (Friedrich-Schiller-Universitaet, Jena (German Democratic Republic). Universitaets-Sternwarte). Astron. Nachr.; 295: No. 3, 141-146(1974).

A review of the possibilities as well as the limits of treating the problem of the collisional history of the asteroids by analytical methods is given. Using empirical data on rock fragmentation and general principles like symmetry and mass conservation the distribution function of fragments arising from a single collision is analytically formulated. The size distributions of asteroids adjusting when crushing collisions have taken place a sufficiently long time can be obtained as the solution of an integro-differential equation with partial derivatives. Quasi-stationary solutions are discussed for particular cases. The problem of the steady state is reduced to the solution of a transcendental equation. (GC)

**12886** MEASUREMENTS OF THE INTERPLANETARY MAGNETIC FIELD IN RELATION TO THE MODULATION OF COSMIC RAYS. Hedgecock, P. C. (Imperial Coll. of Science and Technology, London (UK)). Sol. Phys.; 42: No. 2, 487-527(Jun 1975).

Field strength distributions and low frequency power spectra are derived from interplanetary field measurements made by the HEOS-1 and HEOS-2 satellites during the years 1969-1973. The spectral analysis involved the use of a technique which is shown to allow correctly for missing data. Comparison spectra, derived by the same technique, are presented for the years 1963-1968. The use of near-field-aligned co-ordinates enabled the easy separation of the transverse and longitudinal fluctuation spectra. A power law function involving a "break point" frequency was fitted to each spectrum by a least squares technique. The total power level, the power spectral density at zero frequency and the correlation length are found to vary significantly and in a similar way over the solar cycle. The magnitude and phase of these variations are compared with measurements of the cosmic ray neutron monitor rate and the coronal green line intensity and the influence of mid-latitude solar phenomena on the character of the interplanetary field in the ecliptic is demonstrated. The correlation length and zero frequency power density are found to be considerably larger than previously estimated and, contrary to the usual assumption in modulation theory, the rms amplitude of the perturbation field is comparable to the mean field experienced by the high rigidity particles. Although the mean interplanetary field strength is found to be independent of the level of solar activity, during higher activity the most probable vector average decreases by approximately 0.5 y due to the enhanced directional fluctuation in the field. Power anisotropy measurements suggest that Alfvénic disturbances in the solar wind have fluctuation spectra confined mainly to frequencies larger than $10^{-3}$Hz. The data are interpreted as indicating that the cosmic ray intensity in the Galaxy is some 75% larger than the intensity recorded by neutron monitors on Earth. (auth)

**12887** NEW APPROACH OF THE ADDING METHOD FOR THE COMPUTATIONS OF EMERGENT RADIATION OF AN INHOMOGENEOUS PLANE-PARALLEL PLANETARY ATMOSPHERE. Takashima, T. (Meteorological Research Inst., Tokyo (Japan)). Astrophys. Space Sci.; 36: No. 2, 319-328 (Sep 1975).

The procedure of computing the intensity and the polarization parameters of radiation diffusely reflected and transmitted by an inhomogeneous, plane-parallel planetary atmosphere is discussed with the aid of the adding method. If the atmosphere is simulated by a number of homogeneous sublayers (aerosols and ozone may be included) the matrices of radiation diffusely reflected and transmitted by the atmosphere can be expressed in terms of these matrices of sublayers by using only a couple of iterative equations with the polarity effect of radiation. This procedure is to be extended to the model atmosphere bounded by the surface reflector with a quite arbitrary phase matrix. (NL)

**12888** ION CHEMISTRY IN THE COMETARY ATMOSPHERE. Shimizu, M. (Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science). Astrophys. Space Sci.; 36: No. 2, 353-361(Sep 1975).

Dirty ice of a second kind (major components $H_2O$, CO and $N_2$: minor components less than several percents, $NH_3$, $CH_4$, and other organic substances such as HCN, $CH_3CN$ etc) is assumed for the composition of volatiles in the cometary nucleus. The consistency with the observations of molecular ions and daughter molecules in the cometary atmosphere is argued by taking into account various ion-molecular reactions and dissociative recombinations. There is a satisfactory agreement for the second kind of dirty-ice model, but the presence of large amounts of $CH_4$ and $NH_3$ is found to be rather in contradiction with observational evidence. A velocity of 8 km $s^{-1}$ for the hydrogen atoms, derived from analysis of the hydrogen Lyman-$\alpha$ corona around comets, is found from the dissociative recombination of $H_3O^+$, the dominant constituent of cometary ionosphere, in accordance with $H_3O^+ + e^- \rightarrow OH + H + H$. (NL)

**12889** TITIUS–BODE LAW AND THE POSSIBILITY OF RECENT LARGE-SCALE EVOLUTION IN THE SOLAR SYSTEM. Neito, M. M. (Los Alamos Scientific Lab., NM). Icarus; 25: 171-174(1974).

Although it is by no means clear that the Titius–Bode law of planetary distances is indeed a "law" (even though there are enticing indications), it is proposed that if one assumes that the law is a "law" and that the planets obey it, then this argues against recent large-scale evolution in the solar system. Put another way: one can believe in the Titius–Bode law or in recent large-scale evolution or in neither of them. But it appears difficult to believe in both of them. (auth)

# PHYSICS (ATMOSPHERIC)

## Auroral and Ionospheric Phenomena

*Refer also to abstracts 12172 and 12849.*

**12890** (CONF-740642-, pp E1.1-E1.3) HEATING EXPERIMENTS IN THE IONOSPHERE. Crawford, F. W. (Stanford Univ., CA). 1974.

From 2nd topical conference on RF plasma heating; Lubbock, Texas, USA (20 Jun 1974).

In proceedings of the second topical conference on RF plasma heating. (Texas Tech Univ., Lubbock (USA). Plasma Lab.).

This review provides a key to the literature describing ionospheric heating experiments carried out at Platteville and Arecibo, and to the theoretical work directed towards explaining detailed features of the results. (auth)

**12891** MORPHOLOGY OF THE ALTITUDE OF THE SPORADIC E LAYER. Ovezgel'dev, O. (Inst. of Physics of the Earth and Atmosphere, Ashkhabad, USSR). Izv. Akad. Nauk Turkm. SSR, Ser. Fiz.-Tekh., Khim. Geol. Nauk; No. 4, 55-61(1974). (In Russian)

Morphological characteristics of the altitude of the sporadic E layer are investigated on the basis of data obtained at eight ground stations during the 1958-1965 half cycle of solar activity. Previous investigations are briefly reviewed, and data are presented on the diurnal and seasonal variations in altitude and the possible effects of solar activity. It is concluded that the altitude of the layer has a clearly defined dependence on the time of day with basic diurnal and semidiurnal components, a seasonal dependence whose amplitude and phase depends on the latitude of the observation, and no dependence on solar activity. (IAA)

**12892** DETERMINATION OF POLAR CUSP POSITION BY LOW-ENERGY PARTICLE MEASUREMENTS MADE ABOARD AUREOLE SATELLITE. Gladyshev, V. A.; Jorjio, M. V.; Shuiskaya, F. K. (Institut de Recherches Spatiales, AN SSSR, Moscow); Crasnier, J.; Sauvaud, J. A. (Toulouse-3 Univ., 31 (France). Centre d'Etude Spatiale des Rayonnements). Ann. Geophys.; 30: No. 2, 301-308(Mar 1974). (In French).

The Franco-Soviet experiment ARCAD, launched aboard the satellite AUREOLE December 27, 1971, has verified the existence of a particle penetration from the transition zone up to ionospheric altitudes across the polar cusp. The polar cusp is characterized by proton fluxes $>10^7$ particles/($cm^2$.s.sr.KeV) at 0.5 keV, with energy spectra similar to those in the transition zone. The position and form of the polar cusp are studied from measurements of protons in the range 0.4 to 30 keV during geomagnetically quiet periods (Kp < 3). The polar cusp is located at invariant latitudes near 80 deg. Its movement and changes in shape depend on conditions outside the magnetosphere. The 0.5 keV proton flux is a maximum when the polar cusp is centered at 12 hours M L T and its projection to ionospheric altitudes occupies a region of about 1 deg-2 deg in latitude and 15 deg-23 deg in longitude. (FR)

**12893** DISTRIBUTION OF ELECTRON ION GAS IN THE F REGION OF THE IONOSPHERE. Khantadze, A. G. (Inst. of Geophysics, Tbilisi, USSR). Dokl. Akad. Nauk SSSR; 221: No. 4, 839-841(1 Apr 1975). (In Russian)

**12894** CHEMISTRY OF THE SOLAR NEUTRINO PROBLEM. Jacobs, K. C. (Univ. of Virginia, Charlottesville). Nature (London); 256: No. 5518, 560-561(14 Aug 1975).

Reference is made to the solar neutrino experiment in which attempts are made to detect these neutrinos, on the Earth, by the production of $^{37}Ar^+$ ions in a tank of liquid $C_2Cl_4$. A large discrepancy has appeared between experimental results and theoretical expectations, constituting what is known as the "solar neutrino problem". It is stated that this means that something is awry in our understanding of solar structure theory, nuclear physics, neutrino physics, or the experimental detection chemistry, and although a solution has been extensively sought in the first three of those areas, with little success, the chemical aspect has been largely neglected. An attempt is here made to rectify this omission, and it is suggested that the problem may be purely an artefact of the chemistry of the detection technique. It is suggested that only a small fraction of the $^{37}Ar^+$ produced in the tank used is shown by the Auger counter used; and that what is termed "chemical trapping" occurs. Experimental work supporting this is described, but it is stated that the evidence supporting this chemical hypothesis is purely circumstantial. Mechanisms for the "trapping" of $^{37}Ar^+$ in $C_2Cl_4$ are discussed. (UK)

## Magnetospheric Phenomena

**12895** SHEATH-LIMITED UNIPOLAR INDUCTION IN THE SOLAR WIND. Srnka, L. J. (The Lunar Science Institute, Houston, Texas, USA). Astrophys. Space Sci.; 36: No. 1, 177-204 (Aug 1975).

The collection of charged particles by electrodes in plasmas is controlled by the current voltage characteristics of the plasma sheath which forms at the electrode surface. This principle is applied to the steady-state electromagnetic interaction of the solar wind with moon-like bodies, or "solid-body" interactions. In some cases the unipolar dynamo response of an electrically conducting body in the solar wind motional electric field can be controlled by sheath effects. This occurs for highly conducting bodies when the body radius R is less than a critical value $R_c$, with the result that no induced bow shock wave can form. For the Moon and Mercury $R/R_c > 1$, so that sheath effects do not limit their unipolar responses. The asteroids are found to be either too cold or too small to maintain steady-state induced magnetospheres. The Martion satellites, the irregular Jovian satellites, and the outer satellites of Saturn also have $R/R_c < 1$. No bow shock waves should be generated by these bodies, unless they are highly magnetized or have large magnetic permeabilities. Unipolar induction heating of meteorite parent bodies in a primordial enhanced solar wind should not be inhibited by sheath effects, provided $R \gtrsim 50$ m. (auth)

**12896** SOLAR WIND AND THE MAGNETOSPHERE OF THE EARTH. Cap, F. (Univ., Innsbruck). pp 64-70 of Deutsche Gesellschaft fuer Luft- und Raumfahrt, Yearbook 1973. Cologne; Deutsche Gesellschaft fuer Luft- und Raumfahrt (1974). (In German)

From sixth annual German Society for Aviation and Space Flight and 11th annual Austrian Society for Environmental Research and Flight Technology; Innsbruck, Austria (25 Sep 1973).

Advances made during the time from 1955 to 1965 in the exploration of outer space in the vicinity of the earth are considered, taking into account the properties and the composition of the solar wind and its magnetic characteristics. The effect of the obstacle earth on the solar wind is examined. The solar wind provides near the earth an additional magnetic field which is superimposed on the terrestrial magnetic field. Attention is given to the radiation belt, the whistlers, and the magnetospheric cleft. (IAA)

**12897** EFFECT OF DRIFT-RESONANCE BROADENING ON RADIAL DIFFUSION IN THE MAGNETOSPHERE. Schulz, M. (Aerospace Corp., El Segundo, Calif. (USA). Space Physics Lab.). Astrophys. Space Sci.; 36: No. 2, 455-458(Sep 1975).

In the quasilinear theory of magnetospheric radial diffusion caused by fluctuating electrostatic (E) of magnetic (B) fields, the diffusion coefficient $D_{LL}$ is proportional to the spectral density of E or B at the particle drift frequency $\Omega_3/2\pi$. Since $\Omega_3$ varies with L at fixed M and J (adiabatic invariants), the drift resonance $\omega = \Omega_3$ can be maintained only transiently, and therefore is not perfectly sharp. Its bandwidth $\Delta\omega^*$ is approximately $(16\pi D_{LL}/L^2\Omega_3)^{1/2}\Omega_3$. In magnetospheric radial diffusion caused mainly by electrostatic fluctuations, the value of $\Delta\omega^*/\Omega_3$ typically exceeds 0.4 for particle energies $E \lesssim 40$ KeV. However, the numerical value of $D_{LL}$ is correctly given (within 1% in all cases) by quasilinear theory because the spectrum of E is rather flat at resonance frequencies for which the bandwidth is an appreciable fraction of $\Omega_3$. (Numerical conclusions are based on a quasilinear model for $D_{LL}$ used successfully by Cornwall in 1972.) (NL)

# PHYSICS (ATOMIC AND MOLECULAR)

**12898** CASE STUDIES IN ATOMIC PHYSICS. Volume IV. McDaniel, E. W.; McDowell, M. R. C. (eds.). Amsterdam; North-Holland Publishing Co. (1975). 461p. Dfl. 120,–.

Six studies are presented. Abstracts are included for two of these studies. Of the four remaining, three have been listed in NSA previously as abstract numbers: 32:24918; 32:24917J; and 30:33550. (GHT)

*For abstracts of individual papers see: 12988 and 13091.*

## Beams and Their Reactions

*Refer also to abstracts 13026, 13067, 13782, 13787, 13790–13792, 13795, and 13796.*

**12899** (AECD/EP-29) EXPERIMENTAL SET-UP FOR CHANNELING STUDIES. Khaliquzzaman, M.; Sobhan, M. A.; Mia, M. D.; Hussain, T.; Siddique, A. K. M. (Atomic Energy Centre, Dacca (Bangladesh)). Apr 1975. 17p. Dep. NTIS (US Sales Only) $4.50.

An experimental setup for the studies of various phenomena using channelling effect has been constructed using a three-axis electronically controlled goniometer. A vacuum chamber attachment for the purpose was fabricated. The set-up was checked by doing a back-scattering experiment using silicon single crystal sample. (6 figs, 7 refs) (auth)

**12900** (AERE-R-8147) BOUNDARIES OF ION IMPLANTATION. Freeman, J. H. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1975. 21p. Dep. NTIS (US Sales Only) $4.25. UK £1.00.

The present trend in experimental ion implantation to the use of a wider range of dopants at higher fluences is parallelled by increasing industrial demands to exploit the inherent uniformity and reproducibility of the process. In any practical application, however, the quality and the spatial homogeneity of the doping are ultimately limited by a variety of basic and instrumental factors. The nature of some of these constraints and the boundaries which they set on the scope of ion implantation are described. In particular, certain aspects of profile control, of electrostatic scanning and of ion-beam sputtering and charge-exchange which may be significant in particular doping situations, but which are not widely recognized, are examined. An account is also given of the use of powder implantation as a means of circumventing some surface-area and bulk-doping limitations. (16 figures, 29 references) (auth)

**12901** (CEA-N-1791, pp 41-42) CHARGE EXCHANGE EXPERIMENTS WITH KRYPTON. Baron, E.; Delaunay, B. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The charge state distributions of 370, 440, 550 MeV krypton ions passing through C, Cu, Ag, Au foils of different thicknesses were measured. They were found to agree within about one charge state with the existing semiempirical predictions. (FR)

**12902** (CEA-N-1791, pp 43-44) MEASUREMENT OF THE FRACTION OF HYDROGEN ATOMS FORMED WHEN A PROTON BEAM PASSES THROUGH THIN METALLIC TARGETS. Chateau-Thierry, A.; Delaunay, B.; Gladieux, A. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The fraction $\phi_0 = N(H^0)/N(H^+) + N(H^0)$ of a proton beam passing through a solid metallic target was measured. It was found a Z dependence of the target material, above a proton energy of 1 MeV. The results are in good agreement with the Brandt-Sizmann predictions. (FR)

**12903** (CONF-741040-P1, pp 86-96) INVESTIGATION OF REORDERED (001) Au SURFACES BY POSITIVE ION CHANNELING SPECTROSCOPY, LEED AND AES. Appleton, B. R.; Noggle, T. S.; Miller, J. W.; Schow, O. E. III; Zehner, D. M.; Jenkins, L. H.; Barrett, J. H. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

As a consequence of the channeling phenomenon of positive ions in single crystals, the yield of ions Rutherford scattered from an oriented single crystal surface is dependent on the density of surface atoms exposed to the incident ion beam. Thus, the positive ion channeling spectroscopy (PICS) technique should provide a useful tool for studying reordered surfaces. This possibility was explored by examining the surfaces of epitaxially grown thin Au single crystals with the combined techniques of LEED-AES and PICS. The LEED and AES investigations showed that when the (001) surface was sputter cleaned in ultra-high vacuum, the normal (1 x 1) symmetry of the (001) surfaces reordered into a structure which gave a complex (5 x 20) LEED pattern. The yield and energy distributions of 1 MeV He ions scattered from the Au surfaces were used to determine the number of effective monolayers contributing to the normal and reordered surfaces. These combined measurements were used to characterize the nature of the reordered surface. The general applicability of the PICS technique for investigations of surface and near surface regions is discussed. (auth)

**12904** (CONF-741040-P1, pp 132-138) SITES OF Au ATOMS IN Sn CRYSTALS AS DETERMINED BY CHANNELING. Miller, J. W.; Gemmell, D. S.; Holland, R. E.; Poizat, J. C.; Worthington, J. N.; Loess, R. E. (Argonne National Lab., IL). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

The position of Au atoms diffused into Sn monocrystals has been studied by channeling and backscattering of 2.5-MeV Ne ions. For equilibrium conditions at 217°C, Au atoms are found almost entirely in substitutional positions, so that the unusually fast diffusion of Au in Sn most likely arises from a small fraction of Au atoms migrating interstitially. (auth)

**12905** (JINR-P14-8979) USE OF HEAVY ION BEAMS IN RELATED AREAS OF SCIENCE AND TECHNOLOGY. Barashenkov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.50.

A review is given of the use of heavy ion beams for the preparation of light guides and of devices based on magnetic bubbles and for the simulation of the radiation damage of reactor materials. Properties of nuclear filters, obtained from polymer films by use of heavy ion beams, are briefly discussed. (tr-auth)

**12906** (ORO-2591-75) FORMATION OF EXCITED HYDROGEN ATOMS BY CHARGE TRANSFER AND DISSOCIATION. Progress Report No. 11, December 1, 1974–November 1, 1975. Thomas, E. W.; Zivitz, M.; Rausch, E. O.; Baird, W. E.; Harris, J. E. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). 1 Nov 1975. Contract AT(40-1)-2591. 79p. Dep. NTIS $6.00.

A study of the excited states of atoms backscattered from metal surfaces is presented. Incident ions were $H^+$, $H_2^+$, and $He^+$ at energies of 10 to 30 keV. Preliminary data are presented for a study of the charge state distribution among atoms backscattered from surfaces. Results of a study of light emission from atoms sputtered off targets by 10 to 30 keV $Ar^+$ ions as a way to determine surface contamination are presented. Brief studies of radiation damage by 10 to 30 keV $H^+$ and $He^+$ ions are discussed. 5 figures. (GHT)

**12907** SPECIFIC FLOW RATE IN AN UNPERTURBED FREE-MOLECULAR NITROGEN BEAM. Omelik, A. I. Uch. Zap. TsAGI; 4: No. 5, 110-114(1973). (In Russian)

Specific flow rate, or intensity, is understood to mean the number of molecules that pass in one second through an area of 1 sq cm normal to the beam. The dependence of the specific flow rate on the skimmer geometry and on the characteristics of the flow past the skimmer in the Kantrowitz-Grey (1951) molecular beam generator is investigated. An analysis of the data obtained previously by investigators shows that maximum intensity can be attained only with a free-molecular flow past the skimmer. Empirical expressions are derived which relate the specific flow rate to the braking parameters and the flow conditions at the skimmer. (IAA)

**12908** PARAMETERS OF NONEQUILIBRIUM MOLECULAR BEAMS. Musanov, S. V. Uch. Zap. TsAGI; 4: No. 5, 97-103 (1973). (In Russian)

The behavior of the gasdynamic functions along the axis of an axisymmetric free-molecular beam is analyzed for a wide class of molecular velocity distribution functions. The formulas derived are suitable for calculating the parameters of distribution functions from measured gasdynamic quantities. (IAA)

**12909** INFLUENCE OF THE MATERIAL PROPERTIES ON THE DISINTEGRATION CHARACTERISTICS OF DIELECTRICS. Diniaeva, N. S.; Ryzhov, Yu. A. Izv. Vyssh. Uchebn. Zaved., Aviats. Tekh.; 18: No. 1, 36-38(1975). (In Russian)

The influence of the chemical composition, bond formation energy, and porosity, of the target material (A1203, SiO2, MgO, ZrO2, Y2O3, Cs2O, BN, and AlN) on its disintegration characteristics under bombardment by Ar, Kr, Xe ions with energies between 1 and 15 keV is studied experimentally. It is shown that each of the three material properties studied has an appreciable effect on the disintegration characteristics. (IAA)

**12910** BEAMS OF MOLECULES, ATOMS, AND NUCLEONS. Ramsey, N. F. (Harvard Univ., Cambridge, MA). pp 838-873 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

Lectures are given on beams of molecules, atoms, and nucleons covering recent research activities on molecular beam magnetic resonance experiments, molecular beam electric resonance experiments, hydrogen maser experiments, search for a neutron electric dipole moment, and the National Accelerator Laboratory. (JFP)

**12911** PRODUCTION AND ABUNDANCE MEASUREMENTS OF HIGHLY STRIPPED CARBON AND OXYGEN IONS. Briand, P.; Dupas, L.; Geller, R.; Gormezano, C.; Jacquot, B.; Jacquot, C.; Theiss, A. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Grenoble, 38 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Grenoble, 38(France). Service d'Ionique Generale). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 18, 559-562(12 May 1975). (In French).

The basic principles of an ECR multiply-charged ion source are summarized. Experiment abundance measurements for stripped carbon and oxygen ions are given. (FR)

**12912** IMPLICATION OF CHANNELING PHENOMENA IN THE INDUSTRIAL USE OF ION IMPLANTATION IN SEMI-CONDUCTORS. Monfret, A. (La Radiotechnique Compelec (RTC), 14- Caen (France)). pp 339-353 of Session d'Etudes sur la Canalisation des Particules. Description et Applications. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French)

From meeting on particle channeling; Saclay, France (27 May 1974).

When the first tests were carried out on the application of ion implantation to the manufacture of semi-conductor devices, the advantages to be gained from making use of channeling properties seemed considerable: greater ion penetration, laser defect formation. However, implantation in the easy channeling direction is not applied industrially for reasons which are analyzed: non-reproducibility and complexity of use; development of manufacturing processes; parasitic effects. The means employed on the contrary to avoid channeling of ions during implantation are presented: prebombardment; implantation at increasing energy; implantation through an oxide layer; desorientation of the crystal. The results are shown to be not yet entirely satisfactory. (FR)

**12913** DIRECTIONAL EFFECTS AND SECONDARY ION EMISSION. Slodzian, G. (Paris-11 Univ., 91- Orsay (France). Lab. de Physique des Solides). pp 185-207 of Session d'Etudes sur la Canalisation des Particules. Description et Applications. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French).

From meeting on particle channeling; Saclay, France (27 May 1974).

Experiment and theory have shown that ejection of an atom is induced by collisions taking place essentially in the first layers of the target. The direction of bombardment with respect to the crystal is therefore very important. The implantation of incident ions and the precipitation of the ions implanted were studied, together with the influence of temperature and of the azimuth position of the target on these phenomena. To use the secondary ion emission in analysis it is necessary to eliminate directional effects and hence avoid channeling. Attempts were therefore made to obtain a thin amorphous layer on the crystal surface either by chemisorption of oxygen or by bombardment with polyatomic ions. (FR)

**12914** ATOMIC EFFECTS IN CHANNELING. Poizat, J. C. (Lyon-1 Univ., 69- Villeurbanne (France). Inst. de Physique Nucleaire). pp 163-184 of Session d'Etudes sur la Canalisation des Particules. Description et Application. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French).

From meeting on particle channeling; Saclay, France (27 May 1974).

The atomic effects of the particle which may undergo channeling in solids were observed by studying charge states of the outgoing ion, atomic excitation of the channeled ions and molecular effects due to the relative proximity of two incident particles (molecular ions). (FR)

**12915** DECHANNELING BY DEFECTS. Quere, Y. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Section d'Etude des Solides Irradies). pp 97-128 of Session d'Etudes sur la Canalisation des Particules. Description et Applications. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French).

From meeting on particle channeling; Saclay, France (27 May 1974).

Three types of dechanneling by defects are considered: obstruction, distortion and a combination of the two. Obstruction corresponds to the Sizmann figure (blocking of the channel); distortion means that the channel is curved; in certain cases the two phenomena are combined. This classification enables defects to be distinguished and studied by the type of dechanneling they generate. (FR)

**12916** STEADY-STATE EXCITATION OF A SODIUM BEAM USING A CW LASER. Carter, G. M.; Pritchard, D. E.; Ducas, T. W. (Massachusetts Inst. of Tech., Cambridge). Appl. Phys. Lett.; 27: No. 9, 498-499(1 Nov 1975).

We demonstrate a method for maintaining a large fraction (greater than or equal to 17 percent) of an atomic sodium beam in an excited state. The method uses the Doppler shift to produce, from a single-frequency laser source, a frequency spectrum which prevents optical pumping of the atoms into either of the hyperfine levels of the ground state. A small magnetic field is used to prevent pumping into a magnetic sublevel of the ground state. The method may be used for both the P/sub 1/2/ and P/sub 3/2/ fine-structure levels. (auth)

**12917** FORMATION OF SUPERSONIC BEAMS OF METASTABLE MERCURY, Hg($6\,^3P_0$). Kinetics of Photoexcitation and Intramultiplet Quenching in a Nozzle. Haberman, J. A.; Wilcomb, B. E.; Van Itallie, F. J.; Bernstein, R. B. (Univ. of Wisconsin, Madison). J. Chem. Phys.; 62: No. 11, 4466-4473(1 Jun 1975).

A nitrogen-seeded supersonic nozzle-beam source of metastable mercury, Hg($6^3P_0$), is described. Ground-state ($6^1S_0$) mercury is excited with 2537 A resonance radiation to the $6^3P_1$ state, which is then converted via intramultiplet quenching to the $6^3P_0$ state by collision with nitrogen (the carrier gas). The mercury beam is accelerated by the $N_2$ seeding gas to a speed of $8 \times 10^4$ cm $sec^{-1}$. Thus, the present source provides a beam of a single metastable state, Hg($6^3P_0$), with 4.67 eV of electronic excitation and 0.67 eV of translational energy. The metastable beam has been characterized and the kinetics of the over-all photoexcitation and quenching process studied by a secondary electron (Auger) detector utilizing a potassium suface, and an electron-bombardment ionizer, mass-filter detector. Hg($6^3P_0$) beam intensities of $4 \times 10^{12}$ atoms $sr^{-1}$ $sec^{-1}$ are obtained, based upon an (assumed) 5 percent efficiency for the Auger detector. (auth)

**12918** USE OF THE CHANNELLING TECHNIQUE AND THE THEORY OF FLUX PEAKING EFFECT TO DETERMINE THE LOCATION OF B IN Si. Beloshitskii, V. V. (Moscow State Univ.); Kumakhov, M. A.; Dikii, N. P.; Matyash, P. P.; Skakun, N. A. Radiat. Eff.; 25: No. 3, 167-173(1975).

An experimental and theoretical treatment of the determination of boron atoms in single crystalline silicon, using the channelling effect and flux peaking, is described. (auth)

**12919** TRANSVERSE PLANE FOCUSING AND DECHANNELLING. Pabst, H. J. (Sussex Univ., Brighton, Eng.). Radiat. Eff.; 25: No. 3, 207-208(1975).

In a previous publication the influence of the magnitude of the initial row impact parameter on the subsequent dechannelling of an ion was investigated by means of a computer simulation. Two types of row in the diamond lattice (silicon) were studied. The observation was linked in the previous publication mainly to the effect of row periodicity. It is the purpose of the present communication to indicate that row periodicity does not explain the findings satisfactorily, but that the other possible cause for increased temperature dependence of second row collision dechannelling (which is differing probabilities for head-on row collisions of ions due to the transverse plane geometry) is the more important effect in determining the differences of the minimum yield and the dechannelling parameter for ⟨110⟩ and ⟨111⟩ in the diamond lattice. (UK)

**12920** DETERMINATION OF MOMENTS OF EXPERIMENTAL RANGE DISTRIBUTIONS OF BORON IMPLANTED IN SILICON.

Hofker, W. K. (Philips Research Labs., Amsterdam). Radiat. Eff.; 25: No. 3, 205-206(1975).

A previous publication reported an investigation of the range distributions of boron implanted in amorphous and polycrystalline silicon. The first four moments of these distributions were determined by a fitting procedure with distributions of the Pearson system. A discrepancy was found between experimental and theoretical results for the fourth moment. It was suggested that the discrepancy may be due to a difference between the tails of real boron distributions and of fitting Pearson distributions at boron concentrations which are below the level which can be measured by existing methods. This suggestion is investigated in more detail. (UK)

**12921** ANNEALING BEHAVIOUR OF SILICON BOMBARDED WITH 140 keV $Si^{++}$ IONS. Golanski, A. (Inst. of Nuclear Research, Warsaw); Fiderkiewicz, A.; Rosinski, W.; Bauer, C.; Groetzschel, R.; Rudolph, W. Radiat. Eff.; 25: No. 3, 213-214(1975).

A report is presented on some preliminary results, based on alpha particle channeling measurements, concerning the annealing behaviour of crystalline silicon heavily damaged by Si ions. Misoriented silicon samples were implanted at room temperature with $5 \times 10^{15}$ $cm^{-2}$, 140 keV $Si^{++}$ ions. The samples were then implanted with $6 \times 10^{14}$ $cm^{-2}$, 40 keV $B^+$ ions and annealed at 550, 650 and 800°C. Backscattering analysis was performed along the ⟨111⟩ direction by means of 1.2 MeV alpha particles. The results are given and discussed. (UK)

**12922** CONTAMINATION LAYERS FORMED BY ARGON ION BOMBARDMENT. Shimizu, K. (Electrotechnical Lab., Tokyo); Kawakatsu, H.; Kanaya, K. J. Phys., D (London); 8: No. 13, 1453-1459(11 Sep 1975).

Contamination layers formed on an aluminium substrate by 5 to 35 keV argon ion bombardment have been studied at various ion bombarding times, current densities, ion energies and substrate temperatures. The results are compared with a simple theory which takes sputtering into account and good qualitative agreement is obtained. According to this theory, the higher contamination growth by ion bombardment than by electron bombardment can be explained by the larger cross section for polymerization of organic molecules adsorbed on the surface. Furthermore, it is ascertained that heating the substrate or using a cold trap surrounding the substrate can effectively reduce the contamination growth. (auth)

**12923** NON-CHARACTERISTIC X RAYS IN $Si^+$–Si AND $Ar^+$–Si COLLISIONS IN THE 2 TO 3 MeV RANGE. Heitz, C. (CNRS, Strasbourg). J. Phys., B (London); 8: No. 12, L271-L274(21 Aug 1975).

Thick silicon targets have been bombarded with $Si^+$ and $Ar^+$ ions in the range of 2 to 3 MeV. The observed x-ray spectra show a high-energy contribution which is attributed to radiative electron transitions in the quasi-molecules formed transiently during the collisions. (auth)

**12924** SOME EXPERIMENTAL DATA ON ACCOMMODATION COEFFICIENTS FOR THE NOBLE IONS ON METAL SURFACES. Gusev, K. I.; Rijov, Y. A.; Shkarban, I. I. pp 583-590 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Methods and results of experimental measurements of energy accommodation for $Ar^+$, $Kr^+$, and $Xe^+$ ions with initial energy $E_0$ – 100-500 eV bombarding Cu, Mo, Ag and other (including Mo – monocrystal) foil target are presented. The angular dependencies for the energy accommodation coefficient are obtained within the range of angle $\varphi = 0 + 70$ deg ($\varphi$ is the angle between the target surface normal and the beam direction). (FR)

**12925** MEASUREMENTS ON MULTICHANNEL ARRAYS. The Angular Dependence of the Absolute Intensity and the Velocity Distribution. Beijerinck, H. C. W.; Verster, N. F. (Technische Hogeschool Eindhoven (Netherlands)). pp 365-377 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Three multichannel arrays with channel-diameters of 16, 50 and 140 μm have been investigated using $O_2$ with flow rates of $4\ 10^{-5}$ through $8\ 10^{-3}$ torr $1\ s^{-1}\ mm^{-2}$. All experimental values of the peaking factor K are described by one experimental curve if the peaking factor is reduced by $K^* = KT$, where T is the Clausing factor, and then is plotted vs. the reduced entrance density $\eta^* = L/\lambda$, where $\lambda$ is the mean free path corresponding to the entrance density and L is the length of the channel. At $\eta^* = 1$ the experimental curve lies 40% below Giordmaine and Wang theory, and this deviation increases slightly with increasing $\eta^*$. In the plot of the reduced half-width-half-maximum $\Theta^*_{\frac{1}{2}} = \Theta_{\frac{1}{2}} T^{-1}$ vs. $\eta^*$, all data are also well represented by a single experimental curve. The center-line velocity distribution is described in terms of a deformation function $\Gamma(v)$, to be applied to the Maxwell-Boltzmann velocity distribution from an ideal orifice. (FR)

**12926** GENERAL ASPECTS OF PENETRATION. Brandt, W. (New York Univ., N. Y. (USA). Dept. of Physics; New York Univ., N. Y. (USA). Radiation and Solid State Lab.). pp 9-22 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 May 1974).

The notions on the phenomena of charged particle penetration through the matter are reviewed: spectral function, stopping power and channeling conditions. (FR)

**12927** CHANNELING AND BLOCKING PHENOMENA: DEFINITIONS; GENERALITIES. Sizmann, R. (Muenchen Univ. (F. R. Germany)). pp 23-45 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 May 1974).

The main aspects of channeling and blocking are: incident charged projectiles are steered through a crystal lattice if their angle of incidence is close to a major axial or planar lattice direction (channeling of collimated beams). Channeled particles exhibit a unique impact parameter distribution with high flux density between rows and planes, and almost zero flux density at the regular sites of the target atoms. Due to this impact parameter distribution nuclear and electronic energy loss is reduced. Reactions with target atoms which require close collisions are drastically suppressed, whereas the interactions of the projectiles with interstitial or displaced atoms are enhanced. The propagation of projectiles starting from a lattice site in a solid is suppressed along lattice planes and atomic rows because of the shadow produced by scattering at the neighboring atoms in these planes and rows (blocking of randomly incident projectiles along major axial and planar directions). (FR)

**12928** SURFACE PEAK IN CHANNELING EXPERIMENTS: ENERGY DEPENDENCE. Della Mea, G.; Drigo, A. V.; Lo Russo, S.; Mazzoldi, P.; Yamaguchi, S. (Padua Univ. (Italy). Istituto di Fisica); Bentini, G. G. (Consiglio Nazionale Delle Ricerche, Bologna (Italy)). pp 369-376 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 May 1974).

An attempt was made to clarify the interpretation of the surface peak. The samples, dislocation-free p-type silicon about 300Ω.cm, were etched and anodically oxidized to obtain different surface oxide layers. The oxygen content on the crystal surface can be easily extracted by the dechanneling spectrum. The number of atoms that contribute to the surface scattering yield versus the energy of the incident particle was measured together with the number of Si atoms that contribute to the surface peak versus the number of oxygen atoms at the surface. (FR)

**12929** $Z_1$ OSCILLATIONS IN STOPPING POWER OF METALS FOR LOW VELOCITY CHANNELED HEAVY IONS. Pathak, A. P. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). pp 217-226 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 May 1974).

A model of the stopping of a low velocity heavy ion moving through an electron gas has been used to calculate the stopping power of gold and tungsten for ions ($6 <= Z_1 <= 54$) channeled along ⟨110⟩ Au and ⟨100⟩ W directions. A comparison of the results with experimental data shows satisfactory agreement and a definite improvement over modified Firsov theory in producing deep minima for some of the projectiles. (FR)

**12930** CENTRAL-FIELD INTERMOLECULAR POTENTIALS FROM THE DIFFERENTIAL ELASTIC SCATTERING OF $H_2(D_2)$ BY OTHER MOLECULES. Kuppermann, A.; Gordon, R. J.; Coggiola, M. J. (California Inst. of Tech., Pasadena (USA). Arthur A. Noyes Lab. of Chemical Physics). pp 175-205 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Differential elastic scattering cross sections for the systems $H_2 + O_2$, $SF_6$, $NH_3$, CO, and $CH_4$ and for $D_2 + O_2$, $SF_6$, and $NH_3$ have

been obtained from crossed beam studies. In all cases, rapid quantum oscillations have been resolved which permit the determination of intermolecular potential parameters if a central-field assumption is adopted. These potentials were found to be independent of both the isotopic form of the hydrogen molecule, and the relative collision energy. As a result of this, and the ability of these spherical potentials to quantitatively describe the measured scattering, it is concluded that anisotropy effects do not seem important in these $H_2(D_2)$ systems. (FR)

12931 MOLECULAR BEAM SAMPLING FROM A ROCKET-MOTOR COMBUSTION CHAMBER. Houseman, J. (Jet Propulsion Lab., Pasadena, Calif. (USA)); Young, W. S. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). pp 125-140 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

A molecular-beam mass-spectrometer sampling apparatus has been developed to study the reactive species concentrations as a function of position in a rocket-motor combustion chamber. Unique design features of the sampling system include (a) the use of a multiple-nozzle end plate for preserving the nonuniform properties of the flow field inside the combustion chamber, (b) the use of a water-injection heat shield, and (c) the use of a 300 CFM mechanical pump for the first vacuum stage (eliminating the use of a huge conventional oil booster pump). Preliminary rocket-motor tests have been performed using the highly reactive propellants nitrogen tetroxide/hydrazine ($N_2O_4/N_2H_4$) at an oxidizer/fuel ratio of 1.2 by weight. The combustion-chamber pressure is approximately 60 psig. Qualitative results on unreacted oxidizer/fuel ratio, relative abundance of oxidizer and fuel fragments, and $HN_3$ distribution across the chamber are presented. (FR)

12932 VELOCITY SELECTED ATOMIC HYDROGEN BEAM FOR SCATTERING EXPERIMENTS. Barcellona, A.; Dondi, M. G.; Lagomarsino, V.; Tommasini, F.; Valbusa, U. (Genoa Univ. (Italy). Istituto di Scienze Fisiche). pp 443-456 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

The production, by means of a single hexapolar magnet, of an atomic hydrogen beam with velocity resolution (FWHM) of about 10%, suitable for scattering experiments at thermal energies, is described. (FR)

12933 HIGH EFFICIENCY ATOMIC HYDROGEN SOURCE. Lagomarsino, V.; Bassi, D.; Bertok, E.; De Paz, M.; Tommasini, F. (Genoa Univ. (Italy). Istituto di Science Fisiche). pp 438-442 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Preliminary results of research intended to produce a M.W. discharge atomic hydrogen source with good dissociation at pressures larger than 10 torr are presented. Analysis of the recombination process at these pressures shows that the volume recombination by three body collisions may be more important than wall recombination or loss of atoms by diffusion and flow outside the discharge region. (FR)

12934 ATOMIC BEAM FORMED BY THE VAPORIZATION OF A HIGH VELOCITY PELLET. Foster, C. A.; Hendricks, C. D. (Illinois Univ., Urbana (USA). Dept. of Electrical Engineering). pp 429-437 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

A description of an atomic beam formed by vaporizing an electrostatically accelerated high velocity pellet is given. Uniformly sized droplets of neon will be formed by the mechanical disintegration of liquid jet and frozen by adiabatic vaporization in vacuum. The pellets produced will be charged and accelerated by contacting a needle held at high potential. The accelerated pellets will be vaporized forming a pulse of mono-energetic atoms. The advantages are that a wide range of energies will be possible. The beam will be mono-energetic. The beam is inherently pulsed, allowing a detailed time of flight velocity distribution measurement. The beam will have a high instantaneous intensity. The beam will be able to operate into an ultra high vacuum chamber. (FR)

12935 NON-ALKALI BEAMS IN THE HYPERTHERMAL ENERGY RANGE. Koennen, G. P.; Grosser, J.; Haring, A.; de Vries, A. E. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam (Netherlands). Instituut voor Atoom en Molecuulfysica). pp 411-412 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

An apparatus has been built in which neutral particles are sputtered from a polycrystalline alkali halogen (MX) surface. (FR)

12936 SEXTUPOLE-MAGNET AS VARIABLE VELOCITY SELECTOR FOR PARAMAGNETIC ATOMIC BEAMS IN THE THERMAL RANGE. Spindler, G.; Ebinghaus, H.; Steffens, E. (Hamburg Univ. (F. R. Germany). 1. Inst. fuer Experimentalphysik). pp 391-398 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From 4th international symposium on the molecular beams; Cannes, France (9 Jul 1973).

The possibility of employing a sextupole-magnet as a velocity selector on account of its velocity dependent focusing properties for paramagnetic atomic beams is investigated. In comparison with a traditional velocity selector with rotating disks, a sextupole-magnet as velocity selector has the advantage of additional focusing and polarizing the atomic beam. Moreover it suppresses polymer molecules without an effective magnetic momentum of the electronic shell. (FR)

12937 DIFFRACTION OF $^4$He ATOMS FROM THE (001) FACE OF LiF AT 10°K. Boato, G.; Cantini, P.; Cardillo, M. J.; Tatarek, R. (Genoa Univ. (Italy). Istituto di Scienze Fisiche). pp 1-19 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

A new atom-surface scattering apparatus, which takes advantage of the use of low temperatures, is described. The apparatus allows differential cross section measurements to be carried out with good angular resolution and sensitivity, holding the surface around liquid helium temperatures. The diffractive scattering of a supersonic helium beam from a (001) cleaved LiF surface at 10°K was studied. The normalized integrated intensities of all diffracted peaks for normal incidence are given and compared with a quantum surface rainbow theory developed by LEVI et al. The observation of bound state resonances in the peak intensity plotted as a function of incident angle is discussed. (FR)

12938 ALKALI METAL ADSORBATE SPUTTERING BY MOLECULAR IMPACT. Moran, J. P.; Wachman, H. Y.; Trilling, L. pp 22-24 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

An exploratory study of the sputtering by a krypton molecular beam of rubidium adsorbed at low coverage on a tungsten substrate has been described in a previous paper. An extension of this work is reported now. (FR)

12939 MACH NUMBER FOCUSING IN A SUPERSONIC-MOLECULAR BEAM. Young, W. S.; Sharma, P. K.; Rodgers, W. E.; Knuth, E. L. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). pp 141-144 of Comptes Rendus 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

It is shown that the enrichment factor of a skimmed binary-mixture supersonic molecular beam depends on the hydrodynamic quantities and the skimmer size and location. (FR)

12940 EXPERIMENTAL STUDY OF MOLECULAR BEAM DESTRUCTION BY BEAM–BEAM AND BEAM-BACKGROUND SCATTERING. Bossel, U.; Dettleff, G. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Gottingen (F. R. Germany). Inst. fuer Dynamik Verduennter Gase). pp 149-165 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

The extraction of flow properties related to the molecular motion normal to stream lines of an expanding gas jet from observed intensity profiles of supersonic beams is critically assessed. The perturbation of the profile curves by various effects is studied for a helium beam. Exponential laws appear to describe scattering effects to a satisfactory degree. (FR)

12941 FREE MOLECULE FLOW ANALYSIS OF THE INTERACTION OF SKIMMING HARDWARE COMPONENTS AND BACK-

GROUND GAS WITH FREE JETS. Raghuraman, P.; Bossel, U. (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Goettingen (F. R. Germany). Inst. fuer Dynamik Verduennter Gase). pp 113-124 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Under conditions typical for the extraction of nozzle beams from free jets the rarefied flow pattern in the expansion chamber containing skimming hardware components and background gas is studied using a free molecule solution to the Boltzmann equation. (FR)

**12942** MOLECULAR BEAMS WITH EXTREMELY NARROW VELOCITY SPREADS FROM FREE JET EXPANSIONS. Buck, U.; Dueker, M.; Pauly, H.; Pust. D. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany)). pp 70-82 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Velocity distributions in molecular beams from free jets of light gases (He, $H_2$ and mixtures of 1% Xe in $H_2$) were studied as a function of the source Knudsen number. They were found to be narrower than what would be expected from previous studies. Mach numbers of 50 were observed for helium at a source temperature of T = 85°K. The speed ratio for sources at room temperature was found to be S = 29 for pure $H_2$ and 35 for a 1% Xe-99% $H_2$ mixture. (FR)

**12943** NEW RESULTS IN THE RELATION BETWEEN INTENSITY DISTRIBUTION OF REFLECTED MOLECULAR BEAMS AND SPATIAL DISTRIBUTION OF ELEMENTARY CRYSTAL CELLS IN SOLIDS. Nikuradse, A.; Weidner, J. (Institut fuer Elektronen und Ionenforschung, Muenchen-Solln (F. R. Germany)). pp 25-36 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974). (In French).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Analytic expressions for the intensity distribution of a molecular beam reflected by a solid surface which consists of face centered cubic elementary cells have been studied. The influence of a spatial distribution of the elementary crystal cells on the intensity of reflection has also been studied. Some curves that had been evaluated and designed by a computer are now published. The Kratzer potential of interaction has always been supposed. (FR)

**12944** MOLECULAR BEAM (1-50 eV) PRODUCTION BY DUOPLASMATRON SOURCE. Delmas, M.; Gautherin, G.; Lejeune, C. (Paris-11 Univ., 91—Orsay (France). Inst. d'Electronique Fondamentale). pp 83-92 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974). (In French).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

The duoplasmatron discharge is commonly used to produce intense ion beams. A theoretical model of this discharge has been previously developed. The analysis of charge exchange processes between ions and neutrals within the discharge shows that the source is able to deliver intense neutral beams ($10^{18}$ part $s^{-1}$), the energy being in the range 1-50 eV. The intensity and energy distribution may be controlled from the discharge parameter variations. An experimental device has been realized in order to separate the neutral beam and the flux of charged particles; these latter are injected axially in a toroidal magnetic field configuration. (FR)

**12945** MOLECULAR BEAM FORMATION FROM A HIGH PRESSURE SOURCE. Young, W. S. (California Univ., Los Angeles (USA). School of Engineering and Applied Science). pp 145-148 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Results of studies of shock formation in supersonic flow of air around cones are used to determine the maximum skimmer angle without formation of a detached shock in the free jet regime. Also, since the Mach disk location becomes a critical design parameter in a high-pressure high-temperature sampling system design, its location is predicted using an entropy balance method. Some of the results are outlined here. (FR)

**12946** ABSOLUTE MEASUREMENT OF ALKALINE ATOMS IN A LOW DENSITY JET. Labbe, J.; Guernigou, J. pp 378-390 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974). (In French).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

In order to determine the neutral fraction of cesium vapor which is not ionized in the beam issuing from an ion thruster, a particular sensor was developed at ONERA. This probe, the sensitivity of which is 6 $10^7$ atoms $sec^{-1}$, was used in order to measure the variation of cesium atom flux ejected from a spherical isothermal cavity. Experiments were performed in three flow conditions characterized by the ratio of the mean free path to the dimension of the orifice or to the diameter of the cavity. Results demonstrate that it is possible in this configuration to obtain an efflux of 5 $10^{13}$ atoms $sec^{-1}$ in accordance to cosine law when the mean free path is about the diameter of the spherical cavity. (FR)

**12947** UTILIZATION OF A CHANNEL ELECTRON MULTIPLIER FOR COUNTING-MEASUREMENT ON A CONDENSED MOLECULAR JET. Le Bihan, A. M.; Bottiglioni, F.; Coutant, J.; Fois, M. (Association Euratom-CEA, Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Groupe de Recherches sur la Fusion Controlee; CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Physique du Plasma et de la Fusion Controlee). pp 399-405 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974). (In French).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

A channel electron multiplier has been used for counting ionized clusters containing up to a few thousands molecules; clusters are accelerated towards a negative (approximately-220 V) copper target; a larger negative bias (approximately-3000 V) is applied to the multiplier entrance so as to collect positive secondary ions and/or reflected cluster fragments; in the present application this gives better signal to noise ratio than detecting clusters directly or by secondary electron emission on the target. (FR)

**12948** CONSIDERATIONS ON SPECTROSCOPIC STUDY OF TRIATOMIC MOLECULAR JETS. Pouey, M. (Centre National de la Recherche Scientifique, 92—Muedon-Bellevue (France). Lab. des Interactions Moleculaires et des Hautes Pressions). pp 472-481 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974). (In French).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

To discuss the stability problems of a tri-atomic hydrogen molecule in beam foil spectroscopy, it is necessary to take into account the excited states of the gas target. As high resolution is needed to separate the contributions of the simple excitation and of the dissociation of the gas target, a new corrected mounting using a concave grating is described. The use of the phase balancing method leads to the design of a simple rotating grating mount for which the apparent Doppler broadening can be balanced by a proper defect of focus independent of the wavelength. (FR)

**12949** RECYCLING MOLECULAR BEAM REACTOR. Prada-Silva, G.; Haller, G. L.; Fenn, J. B. (Yale Univ., New Haven, Conn. (USA). Dept. of Engineering and Applied Science). pp 100-112 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

In a Recycling Molecular Beam Reactor, RMBR, a beam of reactant gas molecules is formed from a supersonic free jet. After collision with a target the molecules pass through the vacuum pumps and are returned to the nozzle source. Continuous recycling permits the integration of very small reaction probabilities into measurable conversions which can be analyzed by gas chromatography. Some preliminary experiments have been carried out on the isomerization of cyclopropane. (FR)

**12950** HIGH-FREQUENCY ELECTROMAGNETIC INSTABILITY WITH A BEAM NEAR A SOLID STATE PLASMA. Vyshkind, S. Ya.; Petrov, V. V.; Fainshtein, S. M. (Gorky State Univ., USSR). Sov. Phys.-Tech. Phys. (Engl. Transl.); 20: No. 2, 138-144(1975).

Translated from Zh. Tekh. Fiz.; 45: No. 2, 214-218(Feb 1975).

The nonlinear high-frequency instability of electromagnetic surface waves is studied in a system consisting of an electron beam near a solid state plasma. Synchronism conditions are established and truncated equations are derived for the amplitudes of the interacting waves. It is shown that effective generation of a high-frequency wave is possible with strong low-frequency pumping. Estimates are made of the feasibility of realizing these effects for an InSb semiconductor plasma. (auth)

**12951** ANTISYMMETRICAL BLOCH WAVES AND AXIAL CHANNELING OF ELECTRONS. Gjoennes, J. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Taftoe, J. (Oslo Univ. (Norway). Fysisk Institutt). Phys. Lett., A; 54: No. 1, 55-56(11 Aug 1975).

Channeling of electrons in a direction near a crystal axis is attributed to simple antisymmetrical Bloch waves with few plane wave components. Such waves are expected to exist over a very wide energy range. (auth)

**12952** RANGE PARAMETER DISTORTION IN HEAVY ION IMPLANTATION. Blank, P.; Wittmaack, K. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Neuherberg; Muenchen (F. R. Germany). Physikalisch-Technische Abt.). Phys. Lett., A; 54: No. 1, 33-34(11 Aug 1975).

20 to 145 keV xenon range profiles in silicon have been determined as a function of the implantation fluence. Shortening of the most probable projected range and increase in range straggling were observed at fluences usually implanted for range measurements by means of the backscattering technique. (auth)

**12953** NONLINEAR THEORY OF THE TWO-STREAM INTERACTION. Shcherbinin, G. P.; Khizhnyak, N. A. (Kharkov State Univ.). Sov. Phys.-Tech. Phys. (Engl. Transl.); 20: No. 2, 145-149(1975).

Translated from Zh. Tekh. Fiz.; 45: No. 2, 226-233(Feb 1975).

The asymptotic method is used to analyze the self-consistent one-dimensional nonlinear interaction of two neutralized electron beams with different velocities. The values of the parameters for which growth at the fundamental frequency is not accompanied by significant harmonics is determined. It is shown that in certain regimes the particle trajectories do not intersect ("overtaking") in both the linear and nonlinear stages. (auth)

**12954** DETERMINATION OF SECONDARY IONIC EMISSION COEFFICIENTS FROM SECONDARY ION ENERGY SPECTRA CAUSED BY BOMBARDMENT OF PbS AND LiF SINGLE CRYSTALS BY HELIUM IONS WITH ENERGY FROM 20 TO 2000 eV. Matsevich, V. G.; Zyryanov, G. K. Vestn. Leningr. Univ., Fiz., Khim.; No. 1, 53-55(Feb 1975). (In Russian).

Elastic secondary ionic emission coefficients are found from the energy spectra of scattered ions and by the static method. Inelastic collisions account for the maximum of about 30–40 eV in the energy spectra of secondary ions. The values of secondary ionic emission coefficients within the energy range from 20 to 200 eV are about ten times higher for LiF, than for PbS. (auth)

**12955** CALCULATION OF FOCUSING MAGNETIC FIELD FOR A FLAT BEAM OF CHARGED PARTICLES. Pavinskii, P. P. Vestn. Leningr. Univ., Fiz., Khim.; No. 1, 59-66(Feb 1975). (In Russian).

On the basis of the theory previously published a practical method of calculation of magnetic field has been proposed. The field has the plane and the axis of symmetry and focuses the flat beam exactly. The largest aperture of the beam is equal approximately to 109°. (auth)

**12956** SECONDARY ELECTRON EMISSION OF SOME METALS FOR LOW PRIMARY ELECTRON ENERGIES. Bronshteyn, I. M.; Karasik, B. S.; Pronin, V. P.; Khinich, I. I. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 20: No. 1, 147-148(Jan 1975).

Translated from Radiotekh. Elektron.; 20: No. 1, 209(Jan 1975).

This paper gives $\sigma(E_p)$ and $r(E_p)$ relationships (emission and reflection) for Zr, Mo, La, Ta, W, Re, Ir, and Th. The $\sigma(E_p)$ and $r(E_p)$ curves for all the substances investigated have a well-defined structure. In addition, for Zr, Re, and Ir the values of r for $E_p \sim 1$-2 eV are much higher than for the other metals. The relationships $\sigma(E_p)$ and $r(E_p)$ for W are close to those for the (100) face of a single crystal. X-ray and electron-probe microanalyses showed that after the heat treatment in high vacuum the tungsten single crystal is partitioned into blocks with (100) and (112) faces predominating at the surface. The average lateral size of the blocks is ~20 μm. In the heat treatment of Ta and Mo, the (100) face also predominates at the surface, and the $r(E_p)$ relationships resemble these for W. (DLC)

**12957** GENERATOR PRODUCING NANOSECOND PULSES OF FAST ELECTRONS. Belkin, N. V.; Bogolyubov, V. V.; Kolesov, V. I.; Khudyakova, L. N. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 341-343(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 19-21(1975).

The principle of operation and the characteristics of a portable pulsed source of fast electrons are described. The generator uses a circuit with recharging of a capacitor and an autoelectronic tube with a foil cathode, equipped with a beryllium window for release of the electron beam into the atmosphere. The source creates electron pulses having a length of ~1.5 nsec at the half-height. The amplitude of the accelerating voltage is approximately 200 kV. The maximum electron current is at least 200 A. (auth)

**12958** SECONDARY-ELECTRON EMISSION IN THE BACKWARD AND FORWARD DIRECTIONS FROM THIN CARBON FOILS TRAVERSED BY 25 TO 250 keV PROTON BEAMS. Meckback, W.; Braunstein, G.; Arista, N. (Comision Nacional de Energia Atomica, San Carlos de Bariloche, Argentina). J. Phys., B (London); 8: No. 14, L344-L349(1 Oct 1975).

Kinetic secondary-electron emission from both surfaces, i.e., in the backward and forward directions, is measured and compared when a proton beam (20 to 250 keV) traverses thin carbon foils. It is found that total forward emission is larger than backward emission by a factor of up to 1.55. Electron energy distributions, measured using a retarding field, suggest that an essential contribution to the production of secondary electrons, emitted with energies down to a few eV, originates from binary collisions of the protons with individual electrons in the target. (auth)

**12959** CHARACTERISTIC ELECTRON LOSSES IN GERMANIUM. Speller, L. C. (District of Columbia Teachers Coll., Washington, DC); Mendlowitz, H. J. Phys. Chem. Solids; 36: No. 11, 1229-1232(Nov 1975).

The characteristic electron energy loss spectrum of germanium was studied in a transmission type experiment as a function of the changes in structure due to electron bombardment. The structure of the material was characterized by electron micrograph and diffraction techniques. The electron energy loss spectrum of germanium was studied up to 45 eV, and loss peaks were observed at 15.7 eV and 31.6 eV as well as a 6 eV carbon loss. The positions of the most intense characteristic energy loss peak at 15.7 eV and its first multiple were constant for a large variation in the lattice parameters for the individual films. (auth)

**12960** INVESTIGATION OF ATOM THERMOIONIZATION IN AN ION SOURCE. Maczka, D.; Latuszynski, A.; Zuk, W. (Univ., Lublin). Nukleonika; 20: No. 6, 549-556(1975).

Investigation of the Lu, Sm, Pr, Gd, Tb ion currents emitted by a surface ionization source has been carried out using electromagnetic isotope separator. The results obtained show that there is a considerable agreement of the ion production mechanism with the processes observed in the ion source under investigation. (auth)

# Atomic and Molecular Properties

*Refer also to abstracts 13024, 13041, 13048, 13073, 13086, 13105, 13287, and 13454.*

**12961** (ANL-75-75, pp 206-208) HIGH-RESOLUTION STUDY OF PHOTOIONIZATION IN $H_2$, HD, AND $D_2$. Chupka, W. A.; Dehmer, P. M.; Jivery, W. T. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**12962** (ANL-75-75, pp 209-211) HIGH-RESOLUTION PHOTOIONIZATION STUDY OF ION-PAIR FORMATION IN $H_2$, HD, AND $D_2$. Chupka, W. A.; Dehmer, P. M.; Jivery, W. T. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**12963** (ANL-75-75, pp 237-240) LASER SPECTROSCOPY OF ACTINIDE MOLECULES. Childs, W. J.; Goodman, L. S. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**12964** (BNL-20626) THEORY OF SINGLET-DOUBLET EXCITATIONS IN PRASEODYMIUM. Bak, P. (Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1975. 5p. (CONF-751209-13). Dep. NTIS $4.50.

From 21st annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The magnetic excitation spectrum in a paramagnetic singlet-doublet system is calculated using a diagrammatic high density expansion technique. The lowest order diagrams, which correspond to the random phase approximation (RPA), give a detailed description of the wave vector and temperature dependence of the four exciton modes in praseodymium in terms of a Hamiltonian including isotropic Heisenberg exchange interactions and anisotropic, dipolar-like interactions. The leading contributions to the linewidths of the excitations are obtained by extending the $1/Z$ expansion of the generalized susceptibility propagators one order beyond the random phase approximation. This damping corresponds to

spin wave scattering on single-site fluctuations. The theoretical spectral functions are in detailed agreement with experiment. (auth)

**12965** (CONF-750975-9) AUTOIONIZING STATES IN HIGHLY IONIZED OXYGEN, FLUORINE AND SILICON. Forester, J. P.; Peterson, R. S.; Griffin, P. M.; Pegg, D. J.; Haselton, H. H.; Liao, K. H.; Sellin, I. A.; Mowat, J. R.; Thoe, R. S. (Tennessee Univ., Knoxville (USA); Oak Ridge National Lab., Tenn. (USA)). 1975. 9p. Dep. NTIS $4.50.

From 4th international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

Autoionizing states in high Z 3-electron ions associated with core excited configurations of the type 1s2snl and 1s2pnl are reported. The electron decay-in-flight spectra of lithium-like oxygen, fluorine, and silicon ions are presented. Initial beam energies of 6.75-MeV oxygen and fluorine ions and 22.5-MeV silicon ions were used. Stripping and excitation were done by passing the beams through a thin carbon foil. The experimental technique is described. 4 figs., 1 table, 7 refs. (GHT)

**12966** (LBL-3401) INFRARED SPECTRUM OF CURIUM-244. Conway, J. G.; Blaise, J.; Verges, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Sep 1974. Contract W-7405-ENG-48. 58p. Dep. NTIS $4.50.

The spectrum of curium-244 has been observed on the high resolution Fourier-transform spectrometer at Laboratoire Aime Cotton. An electrodeless lamp containing 50 mu g of $CmI_3$ was run for 12 hours and 800,000 points were taken. A total of 1743 lines have been ascribed to curium and 87 percent of the lines have been assigned to transitions between known energy levels.

**12967** (LBL-3876) LAMB SHIFT IN HYDROGENLIKE IONS. Mohr, P. J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). 11 Nov 1975. Contract W-7405-ENG-48. 9p. (CONF-750975-11). Dep. NTIS $4.50.

From 4th international conference on beam-foil spectroscopy; Gatlinburg, Tennessee, USA (15 Sep 1975).

Experimental and theoretical values for the Lamb shift in hydrogen and in hydrogenic atoms are presented. 3 tables, 32 references. (GHT)

**12968** PROPERTIES OF SOLID AND GASEOUS HYDROGEN, BASED UPON ANISOTROPIC PAIR INTERACTIONS. Etters, R. D. (Colorado State Univ., Fort Collins); Danilowicz, R.; England, W. Phys. Rev., A; 12: No. 5, 2199-2212(Nov 1975).

Properties of $H_2$ are investigated using an analytic anisotropic potential which has been deduced from recent atomic orbital and perturbation calculations. The low-pressure solid results are based upon a spherical average of the anisotropic potential. The calculated ground-state energy is $E_0$ equals -88.76 +- 2 K. The pressure-volume curve agrees with experiment to within 10 percent over the range 9 less than or equal to V less than or equal to 22.65 $cm^3$/mole $H_2$. The high-pressure solid properties are calculated using the anisotropic potential for particular frozen orientations, as well as the spherically averaged potential. The structures investigated are the P/sub a/3 and $P4_2$/mnm orientations. The $P4_2$/mnm orientation yields energies and pressures 10-20 percent lower than either the spherical average or the P/sub a/3 arrangement. Agreement with experimental shock-wave data is tolerable. The metal-insulator phase-transition pressure is predicted to be between $1.61 \times 10^6$ and $3.76 \times 10^6$ atm, depending on the metallic equation of state used. Second virial coefficients B(T) are calculated for $H_2$ and $D_2$ over the range 60 K less than or equal to T less than or equal to 523 K, using a formalism which fully accounts for the potential anisotropies and the discrete rotational spectrum. The results are in excellent agreement with experiment except at high temperatures, where the discrepancy is nearly 10 percent. A comparison of the results with those obtained using the spherically averaged potential indicates that the effect of anisotropies on B(T) is small. This coupled with the results from solid calculations implies that anisotropies are generally not very important except at extremely high pressures. The difference in B(T) between ortho and para $H_2$ and $D_2$ is also calculated. (auth)

**12969** INDEPENDENT-PARTICLE-MODEL POTENTIALS FOR ATOMS AND IONS WITH 36 LESS THAN Z LESS THAN OR EQUAL TO 54 AND A MODIFIED THOMAS–FERMI ATOMIC ENERGY FORMULA. Garvey, R. H.; Jackman, C. H.; Green, A.E.S. (Univ. of Florida, Gainesville). Phys. Rev., A; 12: No. 4, 1144-1152(Oct 1975).

Using the ab initio energy-minimization procedure of Bass, Green, and Wood, two potential parameters, xi and eta are determined, characterizing the independent-particle-model potential of Green, Sellin, and Zachor (GSZ) for atoms and positive ions with 36 less than Z less than or equal to 54. This extends earlier modified-Hartree–Fock (MHF) calculations of Szydlik and Green and of Green, Garvey, and Jackman. It is found that both of the parameters in question display, to a good approximation, a linear dependence on the degree of ionization Z–N for fixed numbers of electrons N. The slopes and y intercepts associated with the linear dependence of xi display marked shell-like behavior, while those associated with eta vary rather smoothly with N. The determinations of total energies are usually within 50 ppm of earlier Hartree–Fock calculations for those cases in which such calculations exist. Using the entire collection of energies and GSZ minimization parameters now available, a modified version of the Thomas–Fermi statistical model (MTF) due to Green, Sellin, and Darewych is reexamined. This model is shown to be capable of yielding the linear Z–N dependence of the GSZ parameters which were found empirically in the MHF work. By numerical adjustment of the coefficients of our MTF model, energies of stable atoms and ions, as well as GSZ potential parameters which are in good agreement with the MHF calculations are obtained. 3 tables, 4 figures. (auth)

**12970** PARITY VIOLATION INDUCED BY WEAK NEUTRAL CURRENTS IN ATOMIC PHYSICS. II. Bouchiat, M. A.; Bouchiat, C. (Ecole Normale Superieure, 75- Paris (France)). J. Phys. (Paris); 36: No. 6, 493-509(Jun 1975).

The first part of this paper gives a detailed account of the evaluation of the electric dipole amplitude induced in alkali one-photon S–S transitions, by the parity violating electron-nucleus short range potential associated with the weak neutral currents. Two methods are presented: the first involves an explicit sum over the contributions of the P-states admixed with the S-states and incorporates the best information available on S–P electric dipole amplitudes. The second method, mathematically more elegant, avoids with the help of Green's function techniques any explicit sum over the P states, and, provided that some spin-orbit corrections are neglected, leads to a fairly simple formula involving Coulomb integrals tabulated in the literature and the interpolated quantum defects for S and P waves. The second part is devoted to a description of possible ways to detect parity violation induced in radiative S–S transitions, with a brief discussion of physical processes which could be a source of experimental difficulty. The last section of the paper deals with a theoretical analysis of the influence of a static electric field on the radiative S–S transitions. An evaluation of the induced electric dipole amplitude in the case of cesium indicates that it will compete with the magnetic dipole amplitude for electric fields larger than 10 V/cm. An interference effect between these two amplitudes gives rise to an electronic polarization in the final atomic state proportional to the vector product of the static electric field by the photon momentum which, in a typical case, could be as large as 64%; the measurement of this interesting and rather peculiar effect will lead to a determination of the sign of the magnetic dipole amplitude. Moreover parity violation could manifest itself by a dependence of this electron polarization on the state of circular polarization of the incident photon. (FR)

**12971** IS THERE A HELIUM MOLECULE. Poulat, C. (Instituto Mexicano del Petroleo, Mexico City); Larsen, S. Y.; Novaro, O. Mol. Phys.; 30: No. 2, 645-648(Aug 1975).

Several analytical forms have been proposed to fit the interatomic potential of the $He_2$ molecule obtained either experimentally or theoretically. Some of these seem to fit fairly well the whole region of the potential from very short distances to quite long range. Aside from this, the ab initio calculations of the correlation energy in the intermediate region of the well permit a very good determination of such parameters as the van der Waals radii and the well depth which are of great importance in determining the ultimate answer: the existence or non-existence of a bound state for this molecule. In the present paper, calculations of the bound-state energies for a series of four different potentials are reported. All of these have a well depth between $0.152 \times 10^{-14}$ and $0.166 \times 10^{-14}$ erg which lie within the normally accepted values. The method and the results are discussed. (auth)

**12972** FIRST DERIVATIVE OF THE CONTINUOUS GENERALIZED OSCILLATOR STRENGTH OF HELIUM WHEN THE CHANGE IN THE MOMENTUM OF THE INCIDENT PARTICLE IS ZERO. Bell, K. L.; Kingston, A. E. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 12, L265-L267(21 Aug 1975).

The first derivative of the continuous generalized oscillator strength of helium has been calculated when the change in the momentum of the incident particle is zero. Quite good agreement is obtained with the experiment of Backx et al. (auth)

**12973** UPPER AND LOWER BOUNDS IN PERTURBATION THEORY. Killingbeck, J. (Hull Univ., Eng.). J. Phys., B (London); 8: No. 12, 1987-1992(21 Aug 1975).

Upper and lower bounds to the second-order energy are obtained by a simple approach which involves two variational

calculations, one for a known quantity and one for $E_2$. The bounds are evaluated for the $E_2(0)$ term in the helium atom ground-state energy. (auth)

**12974** THEORY OF THE STARK EFFECT OF METASTABLE PARAHYDROGEN. English, T. C. (Univ. of Colarado, Boulder); Albritton, D. L. J. Phys., B (London); 8: No. 12, 2123-2132 (21 Aug 1975).

A theory of the Stark effect of the metastable levels of the c $^3\Pi_u$ state of $H_2$ is presented that contains no adjustable parameters and which takes into account the fine structure of the excited triplet states. It is shown that the Stark effect is due almost entirely to the close proximity of the $^3\Sigma_g^+$ state. Numerical values of Stark shifts are calculated and compared with recent experimental values. This allows an assessment of the accuracy of Freis and Hiskes ab initio value of the electronic transition moment connecting the c and a states. The Franck-Condon factors and r centroids used in the numerical computations were calculated from RKR potential curves appropriate for the rotational quantum number N = 2. These potential curves were constructed from new $a^3\Sigma_g^+$ and $c^3\Pi_u$ state molecular constants, which were determined from least-squares fits to the best available experimental rovibronic energy levels. (auth)

**12975** VACANCIES IN SOLID HELIUM. Landesman, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique du Solide et de Resonance Magnetique). Ann. Phys. (Paris); 9: No. 2, 69-92(Mar 1975). (In French).

Some theoretical and experimental properties of thermally excited Schottky type vacancies in solid helium are reviewed: the mechanism for creation of a vacancy and the possibility for the latter to tunnel from one lattice site to a neighbouring one are considered. This tunnelling is compared with Pauli exchange interactions in solid $^3$He. The possibility of vacancy waves is studied and the difference between the cases of $^3$He and $^4$He pointed out. X-ray scattering in body centered cubic helium three yields the energy of formation of vacancies without ambiguity in principle, although with limited accuracy. Vacancy induced diffusion of magnetization in body centered cubic $^3$He is studied by the method of moments and existing experimental data are recalled. Spin lattice relaxation is recalled with some detail, both the Zeeman-vacancies relaxation due to the modulation of the dipole-dipole interactions by the motion of the vacancies and the exchange-lattice relaxation through the vacancies. The Zeeman-vacancies relaxation is studied by the method of moments, in parallel with the theory of diffusion. The exchange-lattice relaxation is calculated by the method of strong collisions of Ailion and Slichter. The various published experiments are reviewed. In the case of body centered cubic helium three, the tunnelling of vacancies can be determined by comparison of NMR activation energies with the energies of formation measured by X-ray scattering. The case of the $^3$He impurities in hexagonal close packed $^4$He is also studied as it also reveals the existence of vacancies in $^4$He. Finally the possibility of inelastic scattering of either neutrons or light by vacancies is noted. It is not possible to detect the vacancy waves directly by such an experiment. (FR)

**12976** CALCULATION OF THE COULOMB CORRELATION ENERGY $U_{ff}$ FOR THE LANTHANIDE SERIES OF RARE EARTH METALS. Cox, B. N.; Lloyd, P. (Monash Univ., Clayton, Australia). J. Phys., F (London); 5: No. 11, L197-L199(Nov 1975).

Recently it has been shown that the effective Coulomb correlation energy of two 3d electrons in an iron series transition metal is approximated by the change in self-consistent Hartree-Fock eigenenergy of a local 3d state that occurs when the occupation of the 3d state that occurs when the occupation of the 3D shell is altered by one. This result has now been applied to the lanthanide series of rare earth metals, and a value of effective Coulomb correlation energy $U_{ff}$ for the 4f electrons deduced. $U_{ff}$ is found to be about 9 eV and nearly constant across the table. (auth)

**12977** SPECTROSCOPIC INVESTIGATION OF DEIONIZATION OF HYDROGEN PLASMA IN RADAR THYRATRONS. Oravec, J.; Gabco, P.; Veghova, K. (Slovenska Vysoka Skola Technicka, Bratislava (Czechoslovakia). Elektrotechnicka Fakulta). Elektrotech. Cas.; 25: No. 9-10, 744-752(1974). (In Slovak)

Possibilities are shown of an experimental investigation of deionization in pulse discharge tubes by the contactless optical method using photomultipliers. From the time course of the plasma light radiation the mechanism of extinction, deionization time constants, coefficients of ambipolar diffusion and electron temperature of the extinguishing plasma are determined. (auth)

**12978** NUCLEAR SPIN-ROTATION INTERACTION IN VIBRATING MOLECULES. II. Vibrational Corrections to the Proton Spin-Rotation Interaction Constant in Hydrides. Voladicheva, M. I.; Rebane, T. K. Vestn. Leningr. Univ., Fiz., Khim.; No. 1, 27-30(Feb 1975). (In Russian).

Vibrational corrections to the proton spin-rotation interaction constants $\Delta C$ for the molecules $H_2$, HD, HF, HCl, HBr and HI are calculated. The proton spin-rotation interaction constant is represented as a sum of three contributions: nuclear—$C^1_{xx}$ electronic—$C^2_{xx}$ and relativistic correction—$C^3_{xx}$. The vibrational corrections $\Delta C^1_{xx}$ and $\Delta C^2_{xx}$ are determined within the adiabatic potential approximation given by Dunham and $\Delta C^2_{xx}$ is evaluated by the vector potential variation method. (auth)

**12979** ELECTRON TRANSITION RADIAL INTEGRALS AND LINE STRENGTHS IN THE COMPRESSED HYDROGEN ATOM MODEL. Ciziunas, A.; Savukynas, A. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 14: No. 5, 741-747(1974). (In Russian).

The model of the compressed hydrogen atom with the boundary conditions for radial orbitals $R(r_0) = 0$, $P'(r_0) = 0$ and $R'(r_0) = 0$ is considered. The dependence of electric multipole transition radial integrals as well as the line strengths on limiting radius $r_0$ is investigated. The numerical solutions of radial Shrödinger equation for hydrogen atom with boundary conditions indicated are used. The decrease of radial integrals near the critical ionization radius is shown. (auth)

**12980** THERMAL NEUTRON SCATTERING BY LIQUID ARGON AND THE INTERMOLECULAR POTENTIAL. Brostow, W. (Montreal Univ., Quebec (Canada)). Chem. Phys. Lett.; 35: No. 3, 387-390(15 Sep 1975).

The most accurate neutron scattering data now available for argon have been used to calculate the interatomic potential. Comparison of results is made for two different procedures, and using several approximations for each procedure. (NL)

**12981** MEASUREMENT OF THE HYPERFINE STRUCTURE OF THE $8^2P/\text{sub } 1/2/$ STATE OF $^{87}$Rb AND THE $9^2P/\text{sub } 1/2/$ STATE OF $^{133}$Cs. Tsekeris, P.; Farley, J.; Gupta, R. (Columbia Univ., New York). Phys. Rev., A; 11: No. 6, 2202-2203(Jun 1975).

The hyperfine structure of the $8^2P/\text{sub } ^1/_2/$ state of $^{87}$Rb and the $9^2P/\text{sub } ^1/_2/$ state of $^{133}$Cs has been measured by a multistep excitation method using a dye laser. Our measured values for the magnetic dipole coupling constant are $A(^{87}\text{Rb}, 8^2P/\text{sub } ^1/_2)$ equals 32.12(11) MHz and $A(^{133}\text{Cs}, 9^2P/\text{sub } ^1/_2/)$ equals 23.19(15) MHz. (auth)

**12982** K-SHELL PHOTOELECTRIC CROSS SECTIONS FOR INTERMEDIATE Z ELEMENTS AT 37 AND 74 keV. Allawadhi, K. L.; Sood, B. S. (Punjab Univ., Patiala, India). Phys. Rev., A; 11: No. 6, 1928-1932(Jun 1975).

K-shell photoelectric cross-section measurements at 36.818 and 74.409 keV, in 15 elements in the range 33 less than or equal to Z less than or equal to 74, have been made using Sood's method with minor modifications which are necessitated because of the nonavailability of clean and strong sources of low-energy photons. No discrepancy between theory and experiment similar to the one reported for the L-shell case has been found. (auth)

**12983** EXCITED STATES OF He: THE BEHAVIOUR OF INTERELECTRONIC ANGULAR DISTRIBUTION FUNCTIONS. Banyard, K. E.; Ellis, D. J. (Leicester Univ., Eng.). J. Phys., B (London); 8: No. 14, 2311-2319(1 Oct 1975).

Interelectronic angular distribution functions $p(\theta_{12})$ and "angular holes" have been examined for correlated descriptions of several excited states of He. One- and two-particle expectation values were determined, including $\tau$—an overall angular correlation coefficient proposed by earlier workers. Although significant differences were observed between the $p(\theta_{12})$ curves for the singlet and triplet multiplicities of the 2P state, the "angular holes" were, in all instances, of similar shape to that obtained for the ground state: however, by comparison, the depths of the excited state "holes" at $\theta_{12} = 0$ were all considerably reduced in value. The detailed structure of the curves enabled observations to be made regarding variations in the electronic shielding of the nucleus and, in particular, allowed a restatement of Hund's multiplicity rule to be substantiated. (auth)

**12984** POTENTIAL ENERGY CURVES FOR ScH. Kunz, A. B.; Guse, M. P.; Blint, R. J. (Univ. of Illinois, Urbana). J. Phys., B (London); 8: No. 14, L358-L361(1 Oct 1975).

Using the generalized valence bond model (GVB), potential energy curves for the $^{1,3}\Sigma$, $^{1,3}\Pi$, $^{1,3}\Delta$ states of ScH are presented. All states are bonding with, at most, a weak barrier and the $^3\Delta$ is the lowest energy state. The bonding is primarily to the $4s^2$ state of Sc. These results are contrasted to like studies of H on Fe, Ni, Mn and Cu. The implications of this study to hydrocarbon catalysis by first-row transition metal catalysts are explored. (auth)

**12985** MEASUREMENT OF THE $n^1D-n^3D$ INTERVALS IN He, n = 8 TO 11. Beyer, H. J.; Kollath, K. J. (Stirling Univ., Eng.). J. Phys., B (London); 8: No. 14, L326-L330(1 Oct 1975).

The singlet-triplet anticrossing method has been employed to measure the $n^1D-n^3D$ intervals in helium for n = 8 to 11. The results, in MHz of 9326 ± 35 (n = 8), 6644 ± 35 (n = 9), 4889 ± 30 (n = 10) and 3696 ± 30 (n = 11) support recent theoretical calculations. (auth)

**12986** NEW VARIATIONAL BOUNDS ON EXPECTATION VALUES. Barnsley, M. F.; Robinson, P. D. (Bradford Univ., Eng.). J. Phys., A (London); 8: No. 10, L95-L98(Oct 1975).

New variational bounds on quantum mechanical expectation values are presented. An illustrative calculation for helium gives encouraging accuracy. (auth)

**12987** THEORY OF THE STARK PROFILE'S ASYMMETRY OF THE HYDROGEN LINES IN A DENSE PLASMA. Demura, A. V.; Sholin, G. V. (Moscow State Inst. of Atomic Energy). J. Quant. Spectrosc. Radiat. Transfer; 15: No. 10, 881-899(Oct 1975). (In Russian).

The asymmetric Stark profile for spectral lines of hydrogen has been calculated in first approximation in terms of the expansion parameter $n^2a_0/R_0$ [$a_0$ = Bohr radius, n = principal quantum number, $R_0 = (^3/_4\pi N)^{\frac{1}{3}}$ = mean distance between charged particles]. Additional terms, which determine the asymmetry, are expressed through the universal functions $\Lambda(\beta)$ and $\chi(\beta)$, which are connected with the first moments of the components of the ion-electric field inhomogeneity tensor. Comparison is made with results based on a nearest neighbour approximation. It is shown that the shift of the symmetry centre of the profiles may be described by the ion-electric field inhomogeneity. (auth)

**12988** RELATIVISTIC SELF-CONSISTENT-FIELD CALCULATIONS WITH APPLICATION TO ATOMIC HYPERFINE INTERACTION. III. Comparison Between Theoretical and Experimental Hyperfine-Structure Results. Lindgren, I.; Rosen, A. (Chalmers Univ. of Tech., Goteborg). Case Stud. At. Phys.; 4: 197-298(1975).

The procedure for the determination of effective radial hyperfine parameters from experimental hyperfine-structure constants is described. A systematic review of experimental hyperfine data for atomic ground configurations is given and comparisons are made with theoretical results. The theoretical values have been obtained with relativistic and non-relativistic self-consistent-field (SCF) wavefunctions using the restricted Hartree-Fock scheme as well as different SCF methods with statistical exchange. In cases where sufficient experimental information is available, the data are analyzed using the effective-operator formalism. Since the relativistic effects on the hyperfine interaction is determined fairly accurately, such an analysis gives a good estimate of the effects due to configuration interaction. (171 refs, 12 figs, 39 tables) (auth)

## Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

*Refer also to abstracts 13084, 13589, and 13775.*

**12989** (BNL-20527) POSITRON ANNIHILATION IN PERFECT AND IMPERFECT METALS: A BRIEF REVIEW. Goland, A. N. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 18p. (CONF-751006-9). Dep. NTIS $4.50.

From international conference on radiation damage in metals; Gatlinburg, Tennessee, USA (5 Oct 1975).

The current renaissance of investigations of positron annihilation in solids has its origins in the observation that positrons interact strongly with certain crystal-lattice defects. Three properties of the annihilation process are being measured to gain information about the defects or about the local environment of the positron at the instant of its annihilation: positron lifetime, angular correlation of the two annihilation quanta, and Doppler broadening of the 511-keV annihilation line. Until the physics of positron behavior in solids is fully understood, the phenomenon will continue to be useful in a manner analogous to electrical resistivity recovery for identifying the recovery stages in irradiated metals. Ultimately, it is destined to provide detailed quantitative information such as the formation volume of vacancies, vacancy-impurity binding energies and electron momentum distributions and densities at defect sites. 2 tables, 52 refs. (auth)

**12990** (JINR-R-12-7423) ON THE ROLE OF PION TRANSFER IN SUPPRESSION OF THE $\pi^-$-MESON CAPTURE BY BOUND HYDROGEN. Risin, V. E.; Petrukhin, V. I.; Suvorov, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 9p. (In Russian). INIS.

11 refs.; 3 figs.

In studies with mixtures containing hydrogen-containing molecules, in a beam of slow $\pi^-$ mesons of the JINR synchrocyclotron the exchange of $\pi^-$ mesons to heavy atoms from $p\pi^-$ mesic atoms formed on bound hydrogen was observed. The specific features of this process are explained and compared with exchange in $H_2$ + Z mixtures. (tr-auth)

**12991** (LA-6073-MS) HIGHER ORDER CORRECTIONS TO ENERGY LEVELS OF MUONIC ATOMS. Rinker, G. A. Jr.; Steffen, R. M. (Los Alamos Scientific Lab., N. Mex. (USA)). Aug 1975. Contract W-7405-ENG-36. 23p. Dep. NTIS $4.00.

In order to facilitate the analysis of muonic x-ray spectra, the results of numerical computations of all higher order quantum electrodynamical corrections to the energy levels of muonic atoms are presented in tabular and graphical form. These corrections include the vacuum polarization corrections caused by emission and reabsorption of virtual electron pairs to all orders, including "double-bubble" and "cracked-egg" diagrams. An estimate of the Delbruecke scattering-type correction is presented. The Lamb-shift (second- and fourth-order vertex) corrections have been calculated including the correction for the anomalous magnetic moment of the muon. The relativistic nuclear motion (or recoil) correction as well as the correction caused by the screening of the atomic electrons is presented in graphs. For the sake of completeness a graph of the nuclear polarization as computed on the basis of Chen's approach has been included. All calculations were made with a two-parameter Fermi distribution of the nuclear charge density. 7 figures, 23 references. (auth)

**12992** ATOMIC AND MOLECULAR PROCESSES INVOLVING HYDROGEN AND DEUTERIUM MUONIC SYSTEMS IN MATTER. Formation and Elastic Scattering of $\mu p$ and $\mu d$ Muonic Atoms. Bertin, A.; Vitale, A. (Univ., Bologna). Riv. Nuovo Cim.; 5: No. 3, 423-497(1975).

The survey of atomic and molecular processes involving hydrogen and deuterium includes atomic capture and cascade process of negative muons in hydrogen and deuterium and scattering processes of $\mu p$ and $\mu d$ in their ground state. (JFP)

**12993** RESONANCES IN LOW-ENERGY POSITRON-HYDROGEN COLLISIONS. Wakid, S. E. A. (Department of Physics, Haigazian College, P. O. Box 1748, Beirut, Lebanon). Phys. Lett., A; 54: No. 1, 103-105(11 Aug 1975).

By explicitly including the positronium channels, and employing a physically motivated wave function, five narrow resonances are detected; three of which lie below the n = 2 threshold of hydrogen and two below the n = 2 threshold of the positronium atom. The respective positions, given in eV above the ground state of hydrogen, are 10.085, 10.195, 10.203, 10.843 and 11.540. Corresponding widths in eV are 4.2(-1), 1.9(-2), 1.1(-3), 1.2 and 5.9(-2). The Nesbet variational method which is a resonance formalism is used here to find these resonances. (auth)

**12994** NUMBER OF FEATURES OF DOUBLE-PHOTON DECAY. Arifov, U. A.; Arifov, P. U.; Shevelev, S. V. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk SSSR; 220: No. 4, 811-813(1 Feb 1975). (In Russian)

The characteristics of decay particles are determined more readily, if the energy of one of the quanta and the emission angle are fixed simultaneously. It is assumed that decay quanta from a point-source sample in a volume dV are registered by two point detectors hooked up in coincidence, one of which is a Ge(Li) detector and the other is a scintillation counter. The distribution energy density of the quanta are measured from the coincidence count rate at fixed angles $\theta_0$ and $\beta_0$. On placing the Ge(Li) detector on a polar axis it is possible to obtain a formula linking an anisotropy function of the distribution momentum density with the count rate function. (SJR)

**12995** WIDTHS AND SHIFTS OF $K^-$ MESIC ATOM LEVELS. Rook, J. R. (Oxford Univ. (UK). Nuclear Physics Lab.). Nucl. Phys., A; 249: No. 3, 466-482(22 Sep 1975).

The optical potential for $K^-$mesons is calculated, and hence the widths and shifts of the $K^-$ mesic atom levels of $^{31}P$ found, assuming that the mesons collide only with single nucleons. A good fit to the experimental values could not be obtained. A fit can be obtained if a complex term proportional to density is added to the calculated $K^-$-nucleus optical potential. To obtain a fit the real and imaginary parts of the added term must be approximately equal. It is suggested that this term arises from interactions of the meson with two nucleons. The additional part of the optical potential arising from collisions with two nucleons is calculated and shown to have roughly the correct ratio of the real and imaginary parts. Other work has suggested that the size of the imaginary part is correct. (NL)

**12996** SACHS MOMENT AND FINITE SIZE EFFECTS IN MUONIC HYPERFINE STRUCTURE. Schaefer, K. (Heidelberg Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 249: No. 3, 523-532(22 Sep 1975).

In calculations of the finite size effect in muonic hyperfine structure, the meson exchange part of nuclear magnetism has so far not been taken explicitly into account. This effect is investigated for the Sachs moment and it is shown that the reduction factor is approximately the same as for the orbital part. Consequences for theoretical values of the h.f.s. constant $A_1$ are discussed for the special nucleus $^{209}Bi$. (NL)

**12997** EFFECT OF NUCLEAR MOTION ON MESONIC ATOM ENERGIES. Seki, R. (California State University, Northridge, Calif. 91324, USA). Phys. Lett., B; 58: No. 1, 49-51(18 Aug 1975).

Nuclear motion in mesonic atoms is shown to contribute to the atomic energies in the same way as in muonic atoms. An exception to this is found to occur in S-states. (NL)

**12998** ENERGIES OF ELECTRONIC K X-RAYS OF MUONIC ATOMS. Vogel, P. (California Inst. of Tech., Pasadena (USA)). Phys. Lett., B; 58: No. 1, 52-54(18 Aug 1975).

The shifts of the electronic KX-rays in muonic atoms are calculated and compared with the recent experimental data. The shifts may be caused either by the incomplete screening of the nuclear charge by the muon, or by the additional electronic vacancies produced by preceding Auger transitions. The first mechanism explains the experiment well. The good agreement between the measured and calculated shifts for $K_\alpha$ and $K_\beta$ x-rays means that the electron L shell is not strongly depleted when the muon has reached orbits with n = 6 to 9. (NL)

**12999** INITIAL DISTRIBUTION IN KAONIC ATOMS. Condo, G. T. (Tennessee Univ., Knoxville (USA)). Phys. Lett., B; 58: No. 1, 55-56(18 Aug 1975).

A comparison of two recent kaonic X-ray experiments indicate that the initial distribution of $K^-$ in the vicinity of the electronic K shell in kaonic atoms has a substantial low angular momentum excess which cannot be accommodated by the conventional parametrization, $(21 + 1)\exp(\alpha 1))$. (NL)

**13000** POSITRON MOTION AND TRAPPING IN IONIC CRYSTALS. Bosi, L. (Istituto de Fisica del Politecnico, Milan); Dupasquier, A.; Zappa, L. Phys. Rev., B; 11: No. 7, 2485-2489 (1 Apr 1975).

Measurements of the temperature effect on the time spectra of positrons annihilated in additively colored KCl show that the rate of positron trapping at F centers per unit F-center concentration is temperature independent in the range 7 to 300°K. The discussion of this new result points out that the trapping process in ionic crystals is not diffusion limited, and, therefore, that the hypothesis, on which was based the derivation of published values of positron diffusion constants, is not confirmed. A secondary result of our experiment is that the mean life of the positron–F-center bound system decreases by approximately 5 percent when the temperature changes from 300 to 7°K. This effect may be attributed to the volume decrease of the void where the system is localized. (auth)

**13001** OBSERVATION OF MANY-BODY EFFECTS IN POSITRON ANNIHILATION IN ALKALI METALS. Kim, S. M.; Stewart, A. T. (Univ. of North Carolina, Chapel Hill). Phys. Rev., B; 11: No. 7, 2490-2499(1 Apr 1975).

The momentum distribution of photon pairs from positrons annihilating in lithium, sodium, potassium, and rubidium has been measured over a wide temperature range. The results were analyzed to yield the momentum dependence of the enhancement factor, positron effective mass, and positron minimum energy in these metals. The annihilation rate at the Fermi momentum was found to be considerably higher than that at zero momentum. The magnitude of this momentum dependence of enhancement factor as well as its variation with the electron density are in good quantitative agreement with the many-body theoretical calculations. Assuming free-particle behavior, the positron effective mass has been determined to be approximately 1.8m in lithium and sodium, 2.1m in potassium, and 2.3 m in rubidium. Using a more realistic momentum distribution for the positron, which includes the positron-phonon interaction, the effective mass observed for sodium would be about 1.4 to 1.6 in fair agreement with a calculation yielding 1.2. The thermalization of positrons was observed to be complete before annihilation down to—for example in Na—160m/m*°K. Below this temperature positrons seem to annihilate with certain minimum effective temperatures or minimum energies. These results are compared with theoretical calculations of the thermalization time of positrons in metals.

## Collision Phenomena

*Refer also to abstracts 12906, 12923, 12928, 12948, 12953, 12982, 12993, 13104, 13780, and 13782.*

**13002** (ANL-75-75, pp 213-216) PHOTOIONIZATION STUDY OF THE REACTION OF $O_2^+(a^4PI/sub\ u/)$ WITH $O_2$. Dehmer, P. M.; Chupka, W. A.; Jivery, W. T. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13003** (CONF-741040-P1, pp 78-85) ENERGY DEPENDENCE OF THE ANISOTROPY OF NONCHARACTERISTIC X-RAYS EMITTED IN FAST ION-ATOM COLLISIONS. Thoe, R. S. (Univ. of Tennessee, Knoxville); Sellin, I. A.; Brown, M. D.; Forester, J. P.; Griffin, P. M.; Pegg, D. J.; Peterson, R. S. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

The effect of beam velocity and K-shell binding energy on the angular distributions of the noncharacteristic x-radiation emitted for various collision pairs. The results are in general agreement with the calculations of Mueller and Greiner, in that the anisotropy increases rapidly with energy, provided that the ions are still moving slowly, compared to the velocity of the K-shell electrons of the separated atoms. The anisotropy in some cases exceeds the maximum permitted by the Mueller–Greiner model for the zero alignment case, implying that strong alignment phenomena also occur. (auth)

**13004** (CONF-741040-P1, pp 120-131) AUGER ELECTRON SPECTROSCOPY APPLIED TO INNER SHELL IONIZATION BY FAST CHARGED PARTICLES. Toburen, L. H. (Battelle Pacific Northwest Lab., Richland, WA). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Until recently, inner shell ionization by charged particle impact was studied almost exclusively through the use of x-ray spectroscopy. This method is limited in accuracy, however, for ionization of inner shells where the fluorescence yield is small. For K-shell ionization of elements with atomic number less than about ten the fluorescence yield can be considered negligible and Auger electron emission cross section provide direct information regarding the ionization cross section. The ionization cross sections determined in this way are accurate to approximately 20 percent whereas x-ray measurements may be uncertain by a factor of five or more due to uncertainties in fluorescence yields. In addition to ionization cross sections, Auger emission spectra provide information regarding multiple ionization, effects of molecular binding on inner shell ionization and, when coupled with x-ray measurements, provide fluorescence yields as a function of the final state of the target atom. These points will be illustrated for ionization by fast protons along with some results for heavier incident particles. (auth)

**13005** (CONF-741040-P1, pp 347-350) COLLISIONAL EXCITATION AND QUENCHING STUDIES USING SMALL ACCELERATORS. Hughes, R. H. (Univ. of Arkansas, Fayetteville). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

A general survey is made of the spectroscopic studies that have been undertaken at the University of Arkansas over a span of several years involving excitation and quenching processes in atomic collisions. The purpose is to show the type of experiments that can be performed with small accelerators in solving the problem of what happens when a fast ion or atom passes through a gas target in terms of the electronic excitation and deexcitation processes. Emphasis has been primarily on fast proton and fast hydrogen atom impact in a typical energy range from about 10 keV to 120 keV. The present program is designed to extend the low energy limit to near 100 eV. (auth)

**13006** (CONF-741040-P1, pp 351-364) ELECTRON INDUCED ATOMIC INNER-SHELL IONIZATION. Quarles, C. A. (Texas Christian Univ., Ft. Worth). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

The current status of cross section measurements for atomic inner-shell ionization by electron bombardment is reviewed. Inner shell ionization studies using electrons as projectiles compliment the similar studies being done with heavy particles, and in addition can provide tests of the theory in those cases when relativistic effects and exchange effects are expected to be important. Both total cross sections and recently measured differential cross sections will be discussed and compared with existing theories where possible. Prospects for further experimental and theoretical work in this area of atomic physics using small electron accelerators will also be discussed. (auth)

**13007** (CONF-741040-P1, pp 374-386) HIGH-RESOLUTION MEASUREMENTS OF X RAYS FROM ION-ATOM COLLISIONS. Knudson, A. R. (Naval Research Lab., Washington, DC). 1974.

From 3rd confereence on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

High resolution measurements of K x-ray spectra produced by ion-atom collisions at MeV energies are presented. These measurements indicate that a distribution of L-shell vacancies accompanies K-shell excitation. The variation of these spectra as a function of incident ion energy and atomic number is discussed. Difficulties in the analysis of these spectra due to rearrangement of vacancies between the time of the collision and the time of x-ray emission are considered. The use of high resolution x-ray measurements to obtain information on projectile ion vacancy configurations is demonstrated by data for Ar ions in KCl. X-ray spectra from Al projectiles in a variety of targets were measured and the effect of target composition on these spectra is discussed. (auth)

**13008** (CONF-741040-P1, pp 387-401) CHARACTERISTIC K-SHELL X-RAY PRODUCTION BY PROTONS BELOW 500 keV. Wheeler, R. M. (SUNY College, Cortland, NY); Chaturvedi, R. P.; Zander, A. R. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

The total thick target yield of K-shell x-rays produced in Ni by incident protons over the energy range 90 to 415 keV was measured. Similar measurements with 130 to 415 keV protons were made for Ti, Mn, Fe, Cu, and Zn. The East Texas State University 150 keV Cockcroft–Walton accelerator was used to study Ni K-shell x-rays produced by 90 to 150 keV protons. The remaining data were taken with the SUNY College at Cortland 400 keV Van de Graaff generator. The characteristic x-rays were measured with high resolution Si(Li) detectors. Using the most recent values of K-shell fluorescent yields, x-ray ionization cross sections were calculated and compared to theoretical predictions based on the binary encounter approximation (BEA) model. It was found that even though the data were lower than those expected by the BEA theory, they lie on a universal curve. A comprehensive summary of x-ray ionization cross section references covering the proton energy range up to 500 keV is also included. Possible applications of low energy accelerators (E/sub p/ less than or equal to 500 keV) for further experimental work is discussed. (auth)

**13009** (CONF-741040-P1, pp 402-409) X-RAY PRODUCTION IN HEAVY ION-ATOM COLLISIONS: 4fsigma ELECTRON PROMOTION. Fortner, R. J. (Univ. of California, Livermore). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

A systematic study is made of x-ray production in ion-atom collisions for electron promotion by 4f sigma molecular orbitals. L x-ray production cross sections are presented for $P^+$, $S^+$, $Cl^+$, $Ar^+$ and $K^+$ projectiles incident on Ar gas targets for projectile energies between 15 and 200 keV. In addition, high resolution L x-ray spectral measurements for $Ar^+$ yields Ar collisions are presented. Average values of the fluorescence yield and total L-shell ionization cross sections are determined. A dramatic Z dependence observed in the x-ray production cross section is attributed to changes in fluorescence yield. New theoretical calculations of argon L fluorescence yield are found to be in reasonable agreement with the experiment for the $Ar^+$ yields Ar case. (auth)

**13010** (CONF-741040-P1, pp 419-426) K-SHELL FLUORESCENT YIELDS FOR MULTIPLY-IONIZED NEON. Moore, C. F. (Univ. of Texas, Austin); Matthews, D. L. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

The use of small accelerators for the production of Auger electrons and x-rays from heavy ion collisions with neon is discussed. High resolution measurements of both K x-rays and K Auger electrons are used to deduce the fluorescent yields for neon singly ionized in the K shell and multiply ionized (ith degree) in the L shell. As an example, the fluorescence yields of $0^{+5}$ bombardment are found to be anti omega/sub i/ (x 100) equals 1.6, 1.7, 1.9, 2.3, 3.9, 7.5 and 23.0 for i equals 0 yields 6 respectively. The omega /sub i/ for high charge states are found to be approximately 2 times larger than that theoretically predicted. Recent improved theoretical calculations which assume a statistical distribution of the possible multiplet states for a given L shell vacancy appear to resolve the discrepancy. (auth)

**13011** (CONF-741040-P1, pp 427-435) IMPACT PARAMETER DEPENDENCE OF INNER-SHELL IONIZATION PROBABILITIES. Cocke, C. L. (Kansas State Univ., Manhattan). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

The probability for ionization of an inner shell of a target atom by a heavy charged projectile is a sensitive function of the impact parameter characterizing the collision. This probability can be measured experimentally by detecting the x-ray resulting from radiative filling of the inner shell in coincidence with the projectile scattered at a determined angle, and by using the scattering angle to deduce the impact parameter. It is conjectured that the functional dependence of the ionization probability may be a more sensitive probe of the ionization mechanism than is a total cross section measurement. Experimental results for the K-shell ionization of both solid and gas targets by oxygen, carbon and fluorine projectiles in the MeV/amu energy range will be presented, and their use in illuminating the inelastic collision process discussed. (auth)

**13012** (CONF-741040-P1, pp 436-448) STUDIES OF L-SHELL X-RAY PRODUCTION FOR FAST IONS ON ELEMENTS WITH Z GREATER THAN OR EQUAL TO 58. Gray, T. J. (North Texas State Univ., Denton). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Studies of L-shell and L-subshell ionization of elements with Z greater than or equal to 58 were accomplished using Si(Li) detector systems in which the major transitions may be resolved. The transitions observed populate the LI-, LII-, and LIII-subshells following ionization by ion species H, He, Li, C and O. Comparison to the nonrelativistic theories which employ screened hydrogenic wave functions has established trends which indicate that the inclusion of effects for increased binding of the target electrons and hyperbolic trajectories for the incident ions give improved agreement between theory and experiment. The inclusion of such effects as suggested by W. Brandt and G. Lapicki for the PWBA will be discussed. (auth)

**13013** (CONF-750820-1) THEORETICAL ASPECTS OF ELECTRON CORRELATIONS IN ELECTRON COLLISIONS. Inokuti, M. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 21p. Dep. NTIS $4.50.

From conference on photoionization and other probes of many-electron interactions; Carry-le-Rouet, France (31 Aug 1975).

Electron-correlation effects manifest themselves in diverse facets of electron collisions with an atom or molecule. A fast incident electron acts largely as an external agent, and its inelastic collisions probe the structure, including correlations within the target (in both the initial state and the final state), nearly in the same way as photoionization processes do. In inelastic collisions of a slow electron, the central object of study is the correlated motion of the incident electron and an electron excited out of the target core. This elementary observation is illustrated in the lecture by many examples and is elaborated by remarks on some current theoretical methods. (auth)

**13014** (CONF-750965-3) SOME NEW EFFECTS SEEN IN THE PASSAGE OF SWIFT ION CLUSTERS THROUGH SOLIDS. Gemmell, D. S.; Remillieux, J.; Poizat, J. C.; Gaillard, M. J.; Holland, R. E.; Vager, Z. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 25p. Dep. NTIS $4.50.

From international conference on atomic collisions in solids; Amsterdam, Netherlands (22 Sep 1975).

Distributions in angle and in energy have been measured for ions transmitted through thin solid targets bombarded by various molecular-ion beams. The results, which differ markedly from those expected on the basis only of a simple "Coulomb explosion," indicate the existence of an additional force tending to align the internuclear vectors of each cluster with the beam direction. An explanation is suggested in terms of a potential attributable to the plasma oscillations generated by the particles as they traverse the solid. Calculations are presented to substantiate this idea. (auth)

**13015** (COO-2130-180) ANNUAL PROGRESS REPORT FOR ATOMIC AND NUCLEAR RESEARCH WITH ACCELERATORS AND FUSION RELATED ATOMIC PHYSICS. Reporting Period, October 1, 1974–September 30, 1975. (Kansas State Univ., Manhattan (USA). Dept. of Physics). Oct 1975. Contract E(11-1)-2130. 111p. Dep. NTIS $6.50.

Topics covered include: laboratory operation and development; atomic collision cross sections in gases; ionization cross sections in thin solid materials; experimental impact-parameter dependent probabilities for k-shell vacancy production by fast heavy-ion projectiles; x-ray spectroscopy with high energy ions; atomic lifetime measurements; polarization studies of ion-induced x rays; theoretical spectra in ion-induced reactions; theoretical atomic cross section calculations; search for heavy-ion resonances; lifetimes of low energy states in $^{21}Ne$; nuclear scattering and reactions; and trace element analysis. (GHT)

**13016** (COO-2562-1) ELECTRON TRANSFER EXPERIMENTS AND ATOMIC MAGNETISM VALUES. Progress Report, February 1, 1975–September 30, 1975. Bayfield, J. E.; Hughes, V. W. (Yale Univ., New Haven, Conn. (USA)). Oct 1975. Contract E(11-1)-2562. 10p. Dep. NTIS $4.50.

Progress in the first seven months of this new research is described. A new apparatus was constructed, tested and moved to Oak Ridge National Laboratory for studies using the Penning ion source test facility. Preliminary electron transfer cross section results for $N^{4+}$, $N^{5+}$, $He^{2+}$ and $C^{3+}$ ions on gases were obtained. Energy loss measurements made to date support expectations that single electron transfer for multiply-charged ions colliding with gas atoms produces excited final state ions. (auth)

**13017** (LA-UR-75-2227) QUASICLASSICAL TRAJECTORY CALCULATIONS OF VIBRATIONAL RELAXATION RATES IN SOME ATOM-DIATOMIC MOLECULE SYSTEMS. Thompson, D. L. (Los Alamos Scientific Lab., N. Mex. (USA)). 1975. Contract W-7405-ENG-36. 19p. (CONF-751142-1). Dep. NTIS $4.50.

From Army symposium on high energy lasers; Redstone Arsenal, Alabama, USA (3 Nov 1975).

Quasiclassical trajectory studies of energy transfer for a number of atom-diatomic molecule systems employing semiempirical (valence-bond) potential-energy surfaces are presented. The systems studied include: $I + H_2$, $Cl + H_2$, $Cl + HCl$, $H + HCl$, $F + HF$, $F + DF$, $H + HF$, $D + HF$, $H + DF$, $D + DF$, $I + I_2$, $Cl + Cl_2$, $H + HBr$, and $Br + HBr$. 10 figures, 16 references. (GHT)

**13018** (LBL-4291) ANODE SPUTTERING CHARACTERISTICS OF THE BERKELEY 2.5 MV SOURCE. Gavin, B. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Oct 1975. Contract W-7405-Eng-48. 6p. (CONF-751077-1). Dep. NTIS $4.50.

From IEEE conference on plasma science; Gatlinburg, Tennessee, USA (27 Oct 1975).

An investigation was made of a number of parameters affecting the performance of the SuperHILAC 2.5 MV Adam injector source. The description will emphasize anode sputtered materials, and will discuss in some detail calcium and gold ion production. Parameters varied include electrode geometry, support gas type and electrode bias, to optimize beam intensity and electrode consumption. A factor of three improvement with high $n^+$ gold ions appears evident with a new displaced electrode geometry. The source is operated in cold mode; is pulsed and operates usually at less than 0.6 amperes average current. Under these conditions source life has been measured to be sixteen hours at 25 percent duty factor, when generating calcium ions, with neon support gas. (auth)

**13019** (ORO-4881-3) ELECTRON EXCITATION CROSS SECTIONS FOR MULTIPLY CHARGED IONS. Progress report, March 1, 1975–February 29, 1976. Henry, R. J. W.; Callaway, J. (Louisiana State Univ., Baton Rouge (USA). Dept. of Physics and Astronomy). 1975. Contract AT(40-1)-4881. 7p. Dep. NTIS $4.50.

Collision strengths for electron impact excitation of $N^{4+}$ and $Ne^{7+}$ are calculated for energies up to three times threshold energy for transitions 2s-2p, 2l-3l' where l equals 0,1 and l' equals 0, 1, 2. A partial wave expansion for the incident electron wave function is made. For an electron with low orbital angular momentum, a closely-coupled expansion method over the 2s, 2p, 3d, 3p and 3d states of the ion is necessary in order to obtain an accuracy of 10 percent. Coulomb-Born approximation methods cannot be relied on for most transitions at the energies considered. A program for regular and irregular Whittaker functions has been developed. This will aid in an investigation of resonance structure in the collision strengths. Differing calculational methods are being investigated in order to compare speed and accuracy. (auth)

**13020** SOFT SPHERE LATTICE SCATTERING AT OBLIQUE INCIDENCE. Barantsev, R. G. (Leningrad State Univ.). Arch. Mech. Stosow.; 26: No. 5, 787-794(1974).

The reflection of gas particles from a lattice of spherical atoms is studied. An analytic solution of the two-dimensional problem is obtained for small parameter specifying the potential barrier deviation from a vertical. The asymptotic approach enables us to split the real collective interaction into a sequence of pairwise collisions. First and second collisions are considered. Exit velocity, scattering indicatrix, momentum and energy exchange coefficients are found depending on the small parameter, mass ratio, lattice stiffness parameter, and incidence angle. (auth)

**13021** VIBRATIONAL RELAXATION OF NO IN COLLISIONS WITH ATOMIC OXYGEN AND CHLORINE. Glaenzer, K.; Troe, J. (Inst. of Physical Chemistry, Lausanne, Switzerland). J. Chem. Phys.; 63: No. 10, 4352-4357(15 Nov 1975).

The vibrational relaxation of $NO(X^2\Pi)$ in the nu equals 0, 1, and 2 states in collisions with Ar, NO, $NO_2$, and electronic ground state O and Cl atoms has been studied in shock waves. O and Cl atoms were produced in the thermal dissociation of $NO_2$ or $N_2O$ at T approximately equal to 2700 K, and of ClNO at T approximately equal to 1700 K, respectively. Both atoms were found to be very efficient catalysts for vibrational energy transfer to NO. The relaxation rates observed suggest a mechanism involving bound $(NO_2)^*$ and $(ClNO)^*$ collision complexes. (auth)

**13022** COLLISION-INDUCED EMISSION FROM $O(^1S)$ BY He, Ar, $N_2$, $H_2$, Kr, and Xe. Black, G.; Sharpless, R. L.; Slanger, T. G. (Stanford Research Inst., Menlo Park, CA). J. Chem. Phys.; 63: No. 10, 4546-4550(15 Nov 1975).

Collision-induced emission from $O(^1S)$ has been studied for collisions with He, Ar, $N_2$, $H_2$, Kr, and Xe. The $O(^1S)$ was made by $CO_2$ photodissociation at 1120 A and $N_2O$ photodissociation at 1290 A. For all but Xe the emitted intensity (including both atomic line and associated molecular bands) increased linearly with the added gas pressure. This was not true at low pressures of Xe--the observed behavior in this case was used to deduce the rates for formation and collisional dissociation of XeO. (auth)

**13023** COLLISION-INDUCED EMISSION FROM $S(^1S)$ BY He, Ar, $N_2$, $H_2$, Kr, AND Xe. Black, G.; Sharpless, R. L.; Slanger, T. G. (Stanford Research Inst., Menlo Park, CA). J. Chem. Phys.; 63: No. 10, 4551-4555(15 Nov 1975).

Collision-induced emission from $S(^1S)$ has been studied for collisions with He, Ar, $N_2$, $H_2$, Kr, and Xe. The $S(^1S)$ was made by OCS photodissociation at 1610 A. The emitted intensity increased linearly with the added gas pressure. This behavior can be described by rate coefficients for induced emission on the $^1S$ yields $^1D$ transition of $(5.6 \pm 0.9) \times 10^{-20}$ $cm^3$ $molecule^{-1}.sec^{-1}$ for helium, $(4.2 \pm 0.3) \times 10^{-18}$ for argon, $(3.3 \pm 0.2) \times 10^{-18}$ for nitrogen, $(1.73 \pm 0.15) \times 10^{-18}$ for hydrogen, $(1.5 \pm 0.1) \times 10^{-17}$ for krypton, and $(1.1 \pm 0.05) \times 10^{-16}$ for xenon. Xenon was also found to enhance the $^1S$ yields $^3P$ emission intensity with a rate coefficient of $(5.5 \pm 1.0) \times 10^{-18}$ $cm^3$ $molecule^{-1}.sec^{-1}$. Induced emission is a major (and possibly exclusive) path for deactivation of $S(^1S)$ by all these gases except hydrogen. (auth)

**13024** RELATIVISTIC AND CORRELATION EFFECTS IN THE 21.2-eV PHOTOEMISSION SPECTRUM OF ATOMIC LEAD. Suezer, S.; Banna, M. S.; Shirley, D. A. (Univ. of California, Berkeley). J. Chem. Phys.; 63: No. 8, 3473-3477(15 Oct 1975).

Photoelectron spectra were obtained for atomic lead in the 700–800°C range, using HeI radiation (21.1 eV) and a special, high-temperature cell. Relativistic effects were obvious, most notably in the relative intensity of 1.000:0.071 in the peaks arising from $Pb^+(s^2p;\ ^2P/sub\ 1/_2/):Pb^+(s^2p;\ ^2P/sub\ 3/_2/)$ states. This is a consequence of the $Pb(s^2p^2;\ ^3P_0)$ ground state being in fact mostly $s^2p^2/sub\ 1/_2/$. Correlation effects were also apparent.

Several final states inaccessible from an $s^2p^2$ initial-state configuration were reached; this was explained by admixtures of the configurations $sp^2d$ and $s^2d^2$ into the initial state. All transitions that would be allowed by the presence of these peaks were actually found. These "direct" observations of configuration interaction give an operational meaning to this concept that is not available to most spectroscopic methods. Energy-loss peaks were observed at higher pressure and attributed to excitation of optical levels in neutral Pb by photoelectrons. (auth)

**13025** ENERGY TRANSFER FROM ARGON RESONANCE STATES TO NITROGEN, HYDROGEN, AND NITRIC OXIDE. McNeely, J. R.; Hurst, G. S.; Wagner, E. B.; Payne, M. G. (Oak Ridge National Lab., TN). J. Chem. Phys.; 63: No. 6, 2717-2723 (15 Sep 1975).

Transfer of electronic energy from the resonance states $Ar(^1P_1)$ and $Ar(^3P_1)$ to diatomic nitrogen, hydrogen, and nitric oxide has been studied with a time-resolved quenching technique. Rate constants for energy transfer were deduced from the changes of the rate of decay of excited states corresponding to known changes of the density of the diatomic molecules. For $Ar^*–N_2$ the rate constants were $5.4 \times 10^{-11}$ and $0.8 \times 10^{-11}$ molecule$^{-1}$ cm$^3$ sec$^{-1}$ for $Ar(^1P_1)$ and $Ar(^3P_1)$, respectively. For $Ar^*–H_2$, the measured rate constants were $22 \times 10^{-11}$ and $21 \times 10^{-11}$ molecule$^{-1}$ cm$^3$sec$^{-1}$ for $Ar(^1P_1)$ and $Ar(^3P_1)$, respectively. The results for nitric oxide were $54 \times 10^{-11}$ and $32 \times 10^{-11}$ molecule$^{-1}$ cm$^3$sec$^{-1}$ for $Ar(^1P_1)$ and $Ar(^3P_1)$, respectively. (auth)

**13026** HIGH RESOLUTION OPTICAL SPECTROSCOPY IN NEON USING A TUNABLE LASER AND AN EXCITED ATOMIC BEAM. Champeau, R. J.; Keller, J. C. (Centre National de la Recherche Scientifique, 91- Orsay (France). Lab. Aime Cotton). J. Phys. (Paris), Lett.; 36: No. 6, L. 161-L.164(Jun 1975).

The hyperfine structures of three absorption lines of neon have been investigated using a single mode tunable dye laser illuminating an atomic beam excited by electron bombardment. Preliminary values for the A and B factors of the $2p_2$, $2p_4$, and $2p_6$ levels are given. (FR)

**13027** CORE-EXCITED AUTOIONIZING STATES IN THE ALKALI METALS. Pegg, D. J.; Haselton, H. H.; Thoe, R. S.; Griffin, P. M.; Brown, M. D.; Sellin, I. A. (Univ. of Tennessee, Knoxville). Phys. Rev., A; 12: No. 4, 1330-1339 (Oct 1975).

An extension of projectile-electron spectroscopy to keV-energy alkali-metal beams has permitted the first observations of the energies of a number of optically forbidden core-excited autoionizing states of the alkali metals. For example, the $(1s2s^2)^2S$ and the $(1s2p^2)^2D$ states of Li which lie at 56.31 ± 0.03 eV and 61.04 ± 0.03 eV, respectively, above the ground state have been located. Energies for theoretically less-well-established doublet and quartet states in Na, $Mg^+$, and K are also presented. 10 figures, 3 tables, 20 references. (auth)

**13028** DOUBLE PHOTOIONIZATION OF NEON. Chang, T. N. (Univ. of Chicago); Poe, R. T. Phys. Rev., A; 12: No. 4, 1432-1439 (Oct 1975).

A calculation of the double photoionization of neon using many-body perturbation theory has permitted a quantitative study of the relative importance of various contributing effects, i.e., ground-state correlations, inelastic internal collisions, core rearrangement, and a virtual Auger transition. The results are in good agreement with experimental data. The energy distribution between two outgoing electrons and the ratio of double to single photoionization are calculated and discussed. (auth)

**13029** ANISOTROPIC INTERBAND EFFECTS IN ELECTROREFLECTANCE OF Ag. Furtak, T. E.; Lynch, D. W. (Ames Lab., Iowa). Phys. Rev. Lett.; 35: No. 14, 960-963 (6 Oct 1975).

Measurements of the normal-incidence electroreflectance of clean, strain-free single crystals of Ag and Au with use of a novel drop-electrolyte technique shown an anisotropy on the (110) face of Ag which is not present on Au. It can be explained by field-induced indirect interband transitions which are observed in Ag but not in Au. This work shows that part of the electroreflectance spectrum of Ag arises from electrons which interact with the periodic crystal potential. (auth)

**13030** MOBILITIES OF $Li^+$ IONS IN He, Ne, AND Ar AND OF $Na^+$ IONS IN He, Ne, Ar, AND $CO_2$. Akridge, G. R.; Ellis, H. W.; Pai, R. Y.; McDaniel, E. W. (Georgia Inst. of Tech., Atlanta). J. Chem. Phys.; 62: No. 11, 4578-4579 (1 Jun 1975).

Results are presented for measurements of the mobilities of $Li^+$ ions in He, Ne, Ar, and of $Na^+$ ions in He, Ne, Ar and $CO_2$ over a wide range of ionic energy, made with a drift tube mass spectrometer at temperatures close to 300°K. 2 figures. (GHT)

**13031** QUASICLASSICAL TRAJECTORY STUDY OF THE $H_2 + F_2$ REACTIONS. Thompson, D. L. (Los Alamos ScientificLab., NM), McLaughlin, D. R. J. Chem. Phys.; 62/ No. 11, 4284-4299 (1 Jun 1975).

A theoretical investigation of the reaction dynamics of the reactions $H_2$(v equals 0,2,4 or 6) + $F_2$(v equals 0 or 6) yields H + HF + F, 2HF, $F_2H$ + H, $H_2F$ + F, $F_2$ + 2H, and $H_2$ + 2F has been accomplished using Monte Carlo averaging over quasiclassical trajectories on a reasonable semiempirical potential-energy surface. The details of the dynamical mechanism of the reaction processes were investigated by examining geometrically restricted reaction paths and selected restricted initial states. Reaction cross sections have been computed and estimates of rate coefficients have been made. The computed thermal rates are many orders of magnitude lower than thermal collision frequencies. Reaction thresholds are lowered significantly for vibrationally excited hydrogen. 10 figures, 9 tables, 59 references. (auth)

**13032** INFERENCE OF CROSS SECTIONS FROM RATE CONSTANTS MEASURED IN DRIFT TUBES. Russ, C.; Parnhill, M. V. III; Woo, S. B. (Univ. of Delaware, Newark). J. Chem. Phys.; 62: No. 11, 4420-4427 (1 Jun 1975).

The feasibility of inferring ion-molecule reaction cross sections from rate constants measured in drift tubes is demonstrated. In order for the rate constants to be of value for such a purpose, the dynamic range and statistical uncertainties of the laboratory data must meet fairly stringent requirements. These requirements are stated and illustrated with numerical examples. Rate constants recently reported in the literature are close to meeting the requirements. Examples also show that the drift tube rate constants can be used to infer threshold energies for ion-molecule reactions to better than 15 mV at thermal energies, if a sufficiently accurate ion-neutral speed distribution is known and rate constants of sufficient dynamic range and accuracy are available. (auth)

**13033** USE OF THE MOMENTUM APPROXIMATION IN CLASSICAL SCATTERING CALCULATIONS. Varelas, C. (Univ., Munich); Sizmann, R. Radiat. Eff.; 25: No. 3, 163-165 (1975).

The validity range of the momentum approximation in binary collisions is investigated. It is shown that at high energies, $E \geq 10 \cdot Z_1Z_2e^2/a_{TF}$, the approximation is even applicable to scattering angles $\Theta$ as large as 60 degrees. An empirical formula for the evaluation of the momentum approximation employing the Thomas-Fermi-Moliere potential is given. It reduces the computer time to calculate $\Theta$ to $\sim 1/10$ of the time consumed in using the standard algebraic functions appearing in the momentum approximation. (auth)

**13034** PHOTON EMISSION INTENSITY AND SPUTTERING EFFICIENCY RELATED TO DRIFT MECHANISMS BELOW THE ION BEAM BOMBARDED SURFACES OF $Na_2O.nSiO_2$ GLASSES. Bach, H. (Jenaer Glaswerk Schott und Gen., Mainz). Radiat. Eff.; 25: No. 209-211(1975).

It was reported in previous publications that during ion beam ablation of $Na_2O.4SiO_2$ glass a change of the concentration profile of Na on the bombarded surface can be shown from intensity/time plots of the simultaneously induced photon emission. These and other recent results allow further conclusions concerning the quantities involved in the exhibition of the Na accumulation immediately below a Na depleted surface layer. These conclusions are discussed. (UK)

**13035** 17th CENTURY TREATMENTS OF ONE-DIMENSIONAL COLLISIONS. Goehring, G. D. (Ohio State Univ., Columbus). Phys. Educ.; 10: No. 6, 457-470(Sep 1975).

The issue of conservation in the collision of bodies aroused considerable interest in the period of its initial investigation. Descartes asserted that the quantity of motion, the scalar product of the mass and speed, was the quantity that was conserved. Huygens, with the aid of his relativity of motion principle, recognized that it was not Descartes' scalar quantity that was conserved, but instead another scalar quantity, the product of the mass and the square of the speed, whose total remained constant. Newton discovered that Descartes' quantity was conserved if considered a vector quantity, and thereby announced the principle of conservation of momentum. Leibniz recognized the conservation of Newton's momentum, and also the conservation of vis viva, the same scalar quantity that Huygens had earlier proposed. Although recognition of the immense importance of these principles had to await further developments in physics, the original formulation of these conservation principles, resulting from the analysis of one dimensional collisions, was completed by the end of the 17 century. (UK)

**13036** ELECTRON TRANSFER FROM A HIGHLY EXCITED RYDBERG (n,1) ATOM TO A MOLECULE: n AND 1 DEPENDENCE OF THE CROSS SECTION. Matsuzawa, M. (Argonne National Lab., IL). J. Phys., B (London); 8: No. 12, 2114-2122 (21 Aug 1975).

Effects of the Coulomb attraction in the final channel are explicitly taken into account on electron transfer from an atom in a highly excited state (n,l) to a molecule. The n and l dependence of this process is related to the energy dependence of thermal-electron attachment to that molecule. It is therefore possible to learn about thermal-electron attachment from the measurement on the electron-transfer process. (auth)

**13037** GROUND-STATE CORRELATION EFFECTS IN He–He INELASTIC SCATTERING. Banyard, K. E.; Szuster, B. J.; Seddon, G. J. (Leicester Univ., Eng.). J. Phys., B (London); 8: No. 12, 2109-2113(21 Aug 1975).

A previous analysis concerning the influence of electron correlation in the ground-state description of He when evaluating inelastic scattering cross sections via the first Born approximation is applied here to an examination of He–He scattering. Excitations of one or both atoms to either a $2\,^1P$ or $3\,^1P$ state are considered along with the example of a mixed ($2\,^1P$, $3\,^1P$) transition. Correlation effects were found to be most important when both atoms were excited, the cross sections being reduced by about a quarter at low impact energies. For the description of angular correlation within He($1\,^1S$), configurations based on p orbitals were always the most significant thus reflecting the symmetry of the excited states. A brief comment is made regarding the elastic cross sections at large impact energies. (auth)

**13038** Ar L-SHELL IONIZATION BY ELECTRONS AND LIGHT IONS: DETERMINATION OF X-RAY EMISSION CROSS SECTIONS AND MEAN FLUORESCENCE YIELDS FOR CHARGE-STATE DISTRIBUTIONS. Langenberg, A. (Rijksuniversiteit, Utrecht); van Eck, J.; de Heer, F. J. J. Phys., B (London); 8: No. 12, 2079-2108(21 Aug 1975).

The absolute cross sections for Ar $L_{2,3}$ x-ray emission have been measured for 0.25 to 14 keV electrons, 30 to 500 keV protons, 30 to 150 keV $H_2^+$, 30 to 800 keV $He^+$, and 600 to 2000 keV alpha particles, incident on argon gas. Experimental problems associated with absolute measurements of the x-ray cross sections, particularly the detection efficiency, are discussed. In order to calculate mean fluorescence yields the x-ray data have been compared with available $L_{2,3}$ Auger-electron-ejection cross sections; the accuracy of the absolute fluorescence yields obtained is about 37%. Results of a similar experiment, but with simultaneous measurement of x-rays and Auger electrons for light ion impact by Stolterfoht and Schneider (unpublished) are within 15% of the present values. An extensive analysis is presented on the outer-shell charge-state distributions of the Ar L ions formed, considering the fraction of normal Auger transitions, the different types of excitation mechanisms and some empirical models. (auth)

**13039** ELECTRON–PHOTON ANGULAR CORRELATIONS IN ELECTRON-HELIUM COLLISIONS FOR $^1P$ EXCITATIONS. Eminyan, M.; MacAdam, K. B.; Slevin, J.; Standage, M. C.; Kleinpoppen, H. (Stirling Univ., Eng.). J. Phys., B (London); 8: No. 12, 2058-2066(21 Aug 1975).

Electron-photon angular correlations have been measured by detecting, in delayed coincidence, electrons inelastically scattered from helium and photons emitted in decays from the $3^1P$ level. The measurements have been carried out using both the $3^1P$-$1^1S$ (53.7nm) line and the $3^1P$-$2^1S$ (501.6nm) line. Analysis of the data yields the ratio of differential cross sections for exciting $3^1P$ magnetic sublevels and the absolute value of the relative phase between the corresponding excitation amplitudes for electron scattering angles between 10° and 30° at incident electron energies in the range 50 eV to 150 eV. Data on the atomic orientation is also presented. The results are compared with the predictions of the first Born approximation and a recent multichannel eikonal calculation. (auth)

**13040** DIFFERENTIAL CROSS SECTIONS OF 100, 150, AND 200 eV ELECTRONS ELASTICALLY SCATTERED IN HELIUM. Kurepa, M. V.; Vuskovic, L. (Inst. of Physics, Belgrade). J. Phys., B (London); 8: No. 12, 2067-2078(21 Aug 1975).

Absolute elastic differential cross sections for electrons in helium have been measured for electron energies of 100, 150 and 200 eV, in the angular range between 5° and 150°. The values have been determined from experimentally measured quantities without normalization to other results. Present cross section values are compared with other experimental and theoretical data available in the literature. (auth)

**13041** DIPOLE TERM AND FIRST DERIVATIVE AT K = 0 OF THE GENERALIZED OSCILLATOR STRENGTH OF He BY keV ELECTRON IMPACT. Backx, C.; Tol, R. R.; Wright, G. R.; van der Wiel, M. J. (Stichting voor Fundamenteel Onderzoek der Materie, Amsterdam). J. Phys., B (London); 8: No. 12, 2050-2057(21 Aug 1975).

An approximate method is described for obtaining the derivative to $K^2$ of the generalized oscillator strength for keV electron scattering at zero momentum transfer, over a large range of energy losses. The measured data enable one to reduce the systematical uncertainty in the derivation of optical oscillator strengths to below the 1% level. Results are presented for He over the spectral range of 19 to 65 eV. The data for the derivative are in satisfactory agreement with earlier electron scattering results at lower impact energy and extend over a sufficient range to allow the application of a sum rule for this term of the generalized oscillator strength. (auth)

**13042** ATOMIC NUMBER DEPENDENCE OF THE PHOTOELECTRIC CROSS SECTION FOR PHOTONS IN THE ENERGY RANGE FROM 4.5 TO 25 keV. Millar, R. H. (Royal Infirmary, Edinburgh). J. Phys., B (London); 8: No. 12, 2015-2022(21 Aug 1975).

Recent experimental values of total attenuation cross section and photoelectric cross section for the elements C, N, O, F, Ne, Mg, Al, Si, P, S, Cl and Ar in the energy range from 4.5 keV to 25 keV, published by Millar and Greening are the first sufficiently comprehensive data set in this range to enable the smoothness of the functional relationship between photoelectric cross section and atomic number to be assessed. The experimental data suggest that the photoelectric cross section is a less smooth function of atomic number than of energy. Interpolated values of total attenuation cross section and photoelectric cross section for sodium are presented, with an assessment of the reliability of such interpolation techniques. (auth)

**13043** ELASTIC SCATTERING OF FAST ELECTRONS AND POSITRONS BY ARGON. Joachain, C. J.; Winters, K. H. (Univ., Brussels). J. Phys., B (London); 8: No. 12, L289-L292(21 Aug 1975).

An ab initio optical model theory is used to analyse the elastic scattering of electrons and positrons by argon in the energy region 100 eV to 1 keV. The calculations are compared with recent absolute measurements of differential cross sections for electron scattering. Total cross sections for electron and positron collisions with argon are also discussed. (auth)

**13044** FINE-STRUCTURE TRANSITIONS IN Li(2p)-He COLLISIONS. Reid, R. H. G. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 13, 2255-2272(11 Sep 1975).

Cross sections for intermultiplet transitions in Li($2p\,^2P$)-He($1\,^1S$) collisions are calculated for impact energies E between $6 \times 10^{-5}$ eV and $6 \times 10^{-2}$ eV by a close-coupled wave treatment. A special study is made of the onset of spin uncoupling as E is increased. The total cross sections indicate that the spin-uncoupled limit (in which the spin of the valence electron is unaffected by the collision) is reached at $3 \times 10^{-4}$ eV. However partial-wave analysis indicates that there are significant departures from the limit up to $3 \times 10^{-3}$ eV. A correlation between peaks in the calculated cross sections and resonances in elastic scattering by the $^2\Pi$ molecular potential is studied, and is interpreted as showing the essentially molecular nature of the collision. (auth)

**13045** ELECTRON SCATTERING FROM ATOMIC HYDROGEN. III. Absolute Differential Cross Sections for Elastic Scattering of Electrons of Energies From 20 to 680 eV. Williams, J. F. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 13, 2191-2199(11 Sep 1975).

Absolute differential elastic cross sections have been measured for the scattering of electrons from atomic hydrogen over the electron energy range from 20 to 680 eV and over the angular range from 10 to 140 degrees. The experimental techniques and method are those associated with crossed electron and modulated atom beams with momentum analysis of the incident and scattered electrons. The measured relative angular distributions were made absolute within 11% by means of the following sequence of measurements (i) a phaseshift analysis around the $(1s2s^3)^2S$ resonance elastic scattering in helium, (ii) relative beam densities of helium and hydrogen beams and (iii) absolute calibration of all apparatus functions. (auth)

**13046** IMPACT PARAMETER FORMULATION OF CLASSICAL FINITE CHARACTERISTIC COLLISION TIME APPROXIMATION. Bates, D. R.; Bates, G. N. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 13, 2249-2254(11 Sep 1975).

The impact parameter version of the classical finite characteristic collision time approximation of Bates and Snyder is formulated and applied to H(1s)-$H^+$ ionizing collisions. The results are in only modest agreement with those obtained by the Born approximation. It is possible that this is partly because the angular momentum (which is important for ionization probabilities though not for ionization cross sections) is incorrectly described in the classical model of the H(1s) atom. (auth)

**13047** RESONANCES AND THEIR EFFECTS ABOVE AND BELOW THE ELECTRON-IMPACT IONIZATION THRESHOLD OF $D_2$. Weingartshofer, A.; Eyb, M. (St. Mary's Univ., Halifax, Nova Scotia). J. Phys., B (London); 8: No. 12, L278-L283(21 Aug 1975).

Two types of spectra of $D_2$ obtained with low energy bombarding electrons and an energy resolution of 40 meV (FWHM) are presented. The energy-loss spectrum in the forward direction (5°) with $E_i$ = 40 meV electrons shows a series of unresolved peaks that agree well with known series of singlet states. On the other hand, the threshold excitation spectrum of $D_2$ shows a simpler structure which is identified as composed of several series of triplet states. Of particular interest is the region near ionization where a well defined series of autoionizing triplets are observed. Most of these states have a very large and sharp excitation cross section at a threshold which has its origin in several series of resonances. Resonance series bands "c", "f" and "g" have been re-examined. (auth)

**13048** ELECTRON IMPACT EXCITATION OF THE $2^1S$ STATE OF HELIUM AT INTERMEDIATE AND HIGH ENERGIES. Byron, F. W. Jr. (Univ. of Massachusetts, Amherst); Joachain, C. J. J. Phys., B (London); 8: No. 12, L284-L288(21 Aug 1975).

The eikonal-Born series method has been applied to analyse the excitation of the $2^1S$ state of helium by electrons of energy E > 100 eV. The EBS results are in good agreement with the experimental data over the entire range of scattering angles. In addition, a simple, but accurate wavefunction has been constructed for the $2^1S$ state of helium. (auth)

**13049** ROTATIONAL EXCITATION OF $HD^+$ BY ELECTRON AND POSITRON IMPACT. Ray, S.; Barua, A. K. (Indian Association for Cultivation of Sciences, Calcutta). J. Phys., B (London); 8: No. 13, 2283-2292(11 Sep 1975).

The rotational excitation cross sections for $\Delta j = \pm 1$ and $\pm 2$ transitions for $HD^+$ by electron and positron impact have been calculated by the semi-classical first-order time-dependent perturbation theory. The trajectory is assumed to be determined by the spherical Coulomb interaction and the transitions are induced by the various non-spherical terms arising from the dipole moment, quadrupole moment and anisotropy of polarizability of $HD^+$. The energy ranges covered are 0.04 eV to 5 eV for electron-$HD^+$ and 0.1 eV to 5 eV for positron-$HD^+$ collisions. The effect of penetration of the charge cloud of $HD^+$ is seen to be small for $\Delta j = \pm 1$ transitions and very large for $\Delta j = \pm 2$ transitions. For electron-$HD^+$ collisions the cross section for rotational excitation decreases with the increase of energy. The reverse is the case of positron-$HD^+$ collisions. (auth)

**13050** EFFECT OF CONFIGURATION-INTERACTION TARGET STATES ON THE ELASTIC SCATTERING OF LOW-ENERGY ELECTRONS BY COMPLEX ATOMS. Smith, E. R. (Cambridge Research Labs., Bedford, MA). J. Phys., B (London); 8: No. 13, 2200-2209(11 Sep 1975).

The total wavefunction (target plus incident electron) is represented by a close-coupling expansion. For complex atoms such as atomic helium and oxygen, the effects of configuration-interaction target states are discussed and analysed, in part. For atomic helium the $^2S$ partial-wave elastic cross section obtained using a He configuration-interaction ground state is virtually identical with the corresponding cross section obtained using a Roothaan-Hartree-Fock ground state. In all cases studied, the elastic phaseshift is shown to increase with the addition of atomic states and explicit correlation states into the expansion for the total wavefunction. For atomic oxygen, the $^4P$ partial-wave elastic phaseshift can increase to such an extent as to cause the $^4P$ partial-wave cross section to go through zero at $k^2 \simeq 0.2$ Ryd. Finally, a second procedure is discussed for including correlation states when CI target states are used in the close-coupling expansion. When this alternative procedure is applied to atomic oxygen, the $^4P$ partial-wave elastic cross section obtained with a configuration-interaction ground state is virtually identical to the cross section obtained with just a single-configuration ground state. (auth)

**13051** STRUCTURE NEAR AUTOIONIZING ENERGIES IN THE EXCITATION OF BOUND STATES OF HELIUM, NEON, AND ARGON BY ELECTRON IMPACT. King, G. C.; Read, F. H.; Bradford, R. C. (Manchester Univ., Eng.). J. Phys., B (London); 8: No. 13, 2210-2224(11 Sep 1975).

Cross sections for the excitation of bound states of atoms by electron impact have been found to contain structures at incident energies near to the energies of short-lived autoionizing states of the target atoms. These structures look superficially like resonances, but in fact they seem to be caused by a post-collision interaction between inelastically scattered and ejected electrons. Examples are given of these structures in He, Ne and Ar. A quantum-mechanical model, is advanced to explain these structures and comparison is made with the experimental data. (auth)

**13052** SCATTERING OF ELECTRONS BY HYDROGEN ATOMS AT INTERMEDIATE ENERGIES: TOTAL AND DIFFERENTIAL CROSS SECTIONS FOR EXCITATION OF n = 2 STATES. Callaway, J. (Imperial Coll. of Science and Tech., London); McDowell, M. R. C.; Morgan, L. A. J. Phys., B (London); 8: No. 13, 2181-2190(11 Sep 1975).

The results of a pseudostate expansion for low-order partial waves ($0 \leq L \leq 3$) are combined with the distorted-wave polarized-orbital method for higher partial waves in order to obtain cross sections for excitation of the 2s and 2p levels of atomic hydrogen by electron impact for incident energies in the range 10 to 30 eV. Both total and differential cross sections are calculated. Results are also presented for Ly$\alpha$ polarization and for the total cross section for all scattering processes. (auth)

**13053** GENERALIZATION OF THE COULOMB-PROJECTED BORN APPROXIMATION. Stauffer, A. D. (Royal Holloway Coll., Englefield Green, Eng.); Morgan, L. A. J. Phys., B (London); 8: No. 13, 2172-2180(11 Sep 1975).

The Coulomb-projected Born approximation proposed by Geltman is generalized by allowing only part of the nuclear charge to act directly on the incident particle. Analytic expressions are derived for elastic scattering cross sections. Results are presented for the 1s-1s, 1s-2s and 1s-2p transitions in H and the 1s-2s transitions in $He^+$. Various criteria for the energy at which the Born approximation becomes valid are discussed. (auth)

**13054** NEON K FLUORESCENCE YIELDS FOR $N^{Q+}$-INDUCED COLLISIONS. Hopkins, F. (State Univ. of New York, Stoney Brook); Woods, C. W.; Kauffman, R. L.; Jamison, K. A.; Richards, P. J. Phys., B (London); 8: No. 13, L319-L320 (11 Sep 1975).

The Ne K Auger electron cross sections for $N^{4+,5+,6+,7+}$ bombardment at 14 and 19 MeV energy are measured. Ne K fluorescence yields are derived using the reported Auger electron cross sections combined with previous x-ray cross section measurements. These fluorescence yields are compared with semi-empirical yields derived from high resolution x-ray spectra. (auth)

**13055** MOLECULAR BEAM SCATTERING EXPERIMENTS AND THE DETERMINATION OF INTERMOLECULAR POTENTIALS. Pauly, H. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany)). pp 242-276 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

The elastic scattering, which will be discussed here, has been most extensively studied. The elastic cross sections show a number of interference effects, since the intermolecular potential consists of both attractive and repulsive forces. All these interferences, which are most pronounced in the thermal energy range and which contain detailed information on the various regions of the intermolecular potential, have been observed now. The exact quantum mechanical treatment of the elastic scattering is well known and numerical techniques for deriving potentials from the measured scattering data are well developed. Experimental methods along with techniques for the evaluation of intermolecular potentials from measurements of total and differential scattering cross sections are summarized in the following section II. A brief survey of the present status of systems studied is given in section III. Examples of important results are described in section IV. Finally, in section V, I illustrate probable trends of future molecular beam work by means of some recently obtained preliminary results. (FR)

**13056** HIGH RESOLUTION MEASUREMENTS OF THE He–He TOTAL SCATTERING CROSS SECTION FOR REDUCED COLLISION ENERGIES BETWEEN 0.2 AND 200. Feltgen, R.; Koehler, K. A.; Pauly, H.; Torello, F.; Vehmeyer, H. (Max-Planck-Institut fuer Stroemungsforschung, Goettingen (F. R. Germany)). pp 304-320 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

The energy dependence of the total scattering cross section is measured for the isotopic systems $^4He-^4He$ and $^3He-^3He$ using a velocity selected He primary beam and a He target in a scattering chamber maintained at 1.57°K. In the low energy region both systems show a pronounced atomic Ramsauer–Townsend effect. At higher energies 13 backward glory extrema in the case of $^4He-^4He$ and 10 extrema for $^3He-^3He$ are observed. From

these extrema the energy dependence of the s-phase shift can be derived. Applying the semiclassical inversion method proposed by Miller it is possible to compute the repulsive potential in the energy range of the measurement. (FR)

13057 TIME-OF-FLIGHT SPECTROSCOPY OF METASTABLE PHOTODISSOCIATION FRAGMENTS IN VACUUM-UV. Fisher, C. H.; Welge, K. H. pp 467-471 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Photofragment time-of-flight experiments carried out at photon energies > approximately 11.8 eV (1050A) is reported. Processes of the kind $AB + h\nu \rightarrow A^* + B$ have been investigated where $A^*$ is an electronically excited species in a metastable state that can be detected by Auger electron emission from metal surfaces. The present work has been concerned with the identification of dissociation processes from $N_2O$, $CO_2$, and OCS measurement of recoil energies and, for the first time, also angular dependent experiments. One objective of the work was to further explore the potential of such studies in the vacuum uv. Their feasibility was demonstrated previously in preliminary experiments. (FR)

13058 THEORETICAL ASPECTS OF CHANNELING. Ritchie, R. H. (Oak Ridge National Lab., Tenn. (USA)). pp 47-67 of Session d'etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 May 1974).

Some aspects of the interaction of charged particles with electrons in condensed matter are discussed. Emphasis is given to the semi-classical model of ion-electron collisions, developed by BOHR, and to the linear response function approach of LINDHARD. The latter is very useful in the study of charged particle interactions in extended, condensed media. Some interesting effects associated with the wake of a charge particle in matter are mentioned. (FR)

13059 STUDY OF HYDROGEN IMPLANTATION IN SILICON. Ligeon, E. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Lab. de Physique du Solide); Guivarc'h, A. (Centre National d'Etudes des Telecommunications (CNET), Centre de Recherches de Lannion, 22 (France)). pp 263-291 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French).

From meeting on particle channeling; Saclay, France (27 May 1974).

The main parameters relative to low-energy hydrogen implantation in a silicon substrate were determined using the 1793 keV resonance of the $^1H(^{11}B,\alpha)\alpha\alpha$ reaction and the backscattering of the channelled $He^+$ ions. The implantated proton and defect creation distribution was measured, together with the stopping power of low-energy protons and of boron ions around 2 MeV. The annealing of implanted layers was studied and the method shown to be well suited to localization research. (FR)

13060 PHOTODISSOCIATION OF $H_2^+$ BY A RUBY LASER WITH ION ENERGY ANALYSIS OF EJECTED $H^+$. Ozenne, J. B.; Pham, D.; Tadjeddine, M.; Durup, J. (Paris-11 Univ., 91-Orsay (France)). pp 591-600 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974). (In French).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

The kinetic energy released in the photodissociation of $H_2^+$ by a ruby laser beam has been measured. The spectrum of the dissociation kinetic energy of $H^+ + H$ shows several vibrational levels, and after deconvolution due to the energetic and angular resolution of the apparatus, gives a population of those vibrational levels, close to theoretical population. (FR)

13061 MOLECULAR BEAM SCATTERING EXPERIMENTS WITH POLAR MOLECULES. I. Differential Elastic Scattering of $H_2 + NH_3$ AND $H_2 + H_2O$. Bickes, R. W. Jr.; Scoles, G.; Smith, K. M. (Waterloo Univ., Ontario (Canada). Dept. of Chemistry). pp 166-174 of Comptes Rendus du 4. Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From fourth international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Differential elastic scattering cross sections with well resolved quantum oscillations have been measured for the system $H_2 + NH_3$ and $H_2 + H_2O$. Assuming a spherically symmetric interaction the data show that a simple spherical potential (i.e. Lennard-Jones) does not properly describe the scattering. (FR)

13062 INVESTIGATION OF FAST H, He ATOM BEAM SCATTERING BY $H_2$ MOLECULES. Leonas, V. B.; Sermyagin, A. V. pp 321-331 of Comptes Rendus du 4th Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From 4th international symposium on the molecular beams; Cannes, France (9 Jul 1973).

The results of the fast beam scattering investigations are used to examine the validity of the theoretical $H-H_2$ and $He-H_2$ intermolecular potentials. (FR)

13063 MASS SEPARATION IN MOLECULAR BEAMS BY CROSSED FREE JETS. Gspann, J.; Vollmar, H. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Kernverfahrenstechnik; Kernforschungszentrum Karlsruhe (F. R. Germany). Inst. fuer Kernverfahrenstechnik). pp 228-241 of Comptes Rendus du 4th Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From 4th international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Molecular beams of xenon, $C_4Cl_3F_7$, or $C_7F_{14}$ generated with a nozzle source using hydrogen as accelerating carrier gas are deflected by crossed free jets of ammonia. Mass spectrometric observation of the isotope abundance in the deflected xenon beam shows an increase of the intensity ratio of the isotopes of mass 129 and mass 132 of about 25% with increasing angle of deflection. (FR)

13064 ROTATIONAL EXCITATION OF LINEAR TRIATOMIC MOLECULES: Ar, Kr + $N_2O$, $CO_2$. Farrar, J. M.; Parson, J. M.; Lee, Y. T. (Chicago Univ., Ill. (USA)). pp 214-227 of Comptes Rendus du 4th Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From 4th international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Rotational excitation of $N_2O$ and $CO_2$ in collisions with Ar and Kr has been studied by crossing two supersonic molecular beams and detecting scattered products with a mass spectrometer. Measurement of the time of flight spectrum of the products as a function of laboratory scattering angle $\theta$ indicates that the inelasticity is concentrated in the forward direction in the center of mass system. Difference between $CO_2$ and $N_2O$ are discussed briefly. (FR)

13065 QUENCHING OF METASTABLE HYDROGEN IN COLLISIONS WITH MOLECULES. Dose, V.; Hett, W. (Wuerzburg Univ. (F. R. Germany). Physikalisches Inst.). pp 282-288 of Comptes Rendus du 4th Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From 4th international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Total cross sections for quenching of metastable hydrogen and deuterium atoms in collisions with some selected molecules have been measured. The velocity range of the matastable projectiles is from 0.48 to $3.6 \times 10^6$ cm/sec. The cross sections have been compared with the predictions of two theoretical treatments by Gersten and Semini which both assume collisional quenching to be due to the interaction of the metastable atom with the molecule's lowest order electric multipole moment. (FR)

13066 SELF-SCATTERING CROSS SECTION OF MOLECULES IN A BEAM. Lou, Y. S. (Delaware Univ., Newark (USA)). pp 289-303 of Comptes Rendus du 4th Symposium International sur les Jets Moleculaires. Paris, France; Bartheye (1974).

From 4th international symposium on the molecular beams; Cannes, France (9 Jul 1973).

Molecular collision cross-section has always been measured by the beam scattering method, or by the measurements of thermal conductivity and/or viscosity coefficient, etc. The cross section thus obtained has been found to be different, qualitatively, from that of the self-scattering of the molecules moving within a molecular beam. By perturbing the zeroth order solution of the Boltzmann equation with a B-G-K kinetic model for the gas upstream to the orifice, and performing particle scattering calculation for molecules within the beam downstream to the orifice, such self-scattering collision cross section can be determined from the experimental data of velocity distribution functions of molecules in the beam. (FR)

13067 ELECTRONIC STRUCTURE OF CLUSTERS PRODUCED BY ION SECONDARY EMISSION. Leleyter, M.; Joyes, P. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique des Solides). J. Phys. (Paris), Colloq.; No. 2, 29(1975). (In French)

From colloquium on the dense random packing structure; Orsay, France (19 Jun 1974). Published in abstract form only.

13068 RATE CONSTANTS FOR THE $CO_2$ $02^0$-$10^0$ RELAXATION. Jacobs, R. R.; Pettipiece, K. J.; Thomas, S. J. (Univ. of

California, Livermore). Phys. Rev., A; 11: No. 1, 54-59(Jan 1975).

An absorption-cell technique is utilized to determine the rate constants for the $CO_2$ $02^00$-$10^00$ relaxation in $CO_2$ and binary-gas mixtures of $CO_2$-He and $CO_2$-$N_2$. The experiment consists of injecting an approximately 2-nsec 10.4-mu m pulse through the absorption cell—saturating the $CO_2$ $10^00$ to $00^01$ transition, and monitoring the subsequent molecular re-equilibrations by recording the temporal intensity of a spatially overlapping probe beam in the 9.4-mu m band connecting the $02^00$ and $00^01$ states. The measured rate constants are k/sub $CO_2$-$CO_2$/ equals 3 + 1, k/sub $CO_2$-He/ equals 0.8 + 0.3, and k/sub $CO_2$-$N_2$/ equals 3 + 1, all in units of $10^5$ $sec^{-1}$ $Torr^{-1}$. The experimental approach also yields information on the thermalization of other processes having slower rates, and these are discussed qualitatively. Finally, a comparison is made with other related experimental investigations and two calculations which predict values for k/sub $CO_2$-$CO_2$/ appreciably different from those measured. (5 figs., 16 refs.) (auth)

**13069** MULTICHANNEL PHOTODETACHMENT THEORY. Lee, C. M. (Univ. of Chicago). Phys. Rev., A; 11: No. 5, 1692-1699(May 1975).

A general theoretical treatment of multichannel photodetachment is presented, with application to $Cs^-$ photodetachment from 14,800 to 15,600 $cm^{-1}$. The sharp and strong resonances near the first $^2P$ states of the Cs atom, observed by Patterson et al., were reproduced by fitting eight physically meaningful parameters of a general theoretical framework. Predictions are also made concerning the branching ratios, the angular distribution, and the spin orientation of the detached electrons as well as the orientation of the excited neutral Cs atoms. (auth)

**13070** SCATTERING OF EXCITED ATOMS BY GROUND STATE ATOMS. Application of $He_2^*$. Andresen, B.; Kuppermann, A. (California Inst. of Technology, Pasadena). Mol. Phys.; 30: No. 4, 997-1004(Oct 1975).

Regular oscillations in the differential cross section (DCS) due to nuclear symmetry are used as a sensitive tool to obtain potential curves from measurements. The method is very sensitive to the presence and height of repulsive barriers in the potentials. The DCS for He ($1^1S$)-He($2^1S$) collisions at 63 meV using the $A^1\Sigma_u^+$ and $C^1\Sigma_g^+$ potential curves of Guberman and Goddard are compared with molecular beam experiments of Haberland, Chen and Lee, and a reduction of the calculated barrier heights by 15% is indicated. Calculations at other collisions energies suggest that measurements of the DCS as a function of energy are a sensitive way of determining experimentally the $A^1\Sigma_u^+$ and $C^1\Sigma_g^+$ curves of $He_2$. (auth)

**13071** A MULTISTATE SEMICLASSICAL ORBITAL TREATMENT OF HEAVY PARTICLE COLLISIONS WITH APPLICATIONS TO H-$H_2$ ROTATIONAL TRANSITIONS. McCann, K. J.; Flannery, M. R. (Georgia Inst. of Tech., Atlanta (USA). School of Physics). Chem. Phys. Lett.; 35: No. 1, 124-130(15 Aug 1975).

A new semiclassical description of elastic and inelastic scattering in heavy-particle collisions is developed. The treatment includes appropriate trajectories determined from a certain optical potential designed to couple the response of the internal structure to the orbit for the relative motion. The procedure is applied to various rotational transitions in H-$H_2$ collisions at 0.5-1.5 eV and yields results remarkably close to recent quantal calculations. (auth)

**13072** RADIATIVE COLLISIONS IN EXCHANGE INTERACTIONS. Gudzenko, L. I.; Yakovlenko, S. I. (Lebedev Inst. of Physics, Moscow). Sov. Phys.–Tech. Phys. (Engl. Transl.); 20: No. 2, 150-154(1975).

Translated from Zh. Tekh. Fiz.; 45: No. 2, 234-241(Feb 1975).

Radiative collisions, i.e., elementary events in which the colliding particles emit a photon as a result of a change in electronic shell structure, are analyzed. In contrast with previous work, the analysis deals with the case in which the photon emission is due to an exchange (rather than polarization) interaction of the colliding particles. The shape of the radiative-collision spectral line is analyzed. The case of a strong external field is treated; in this case the absorption of a photon in a radiative collision is nonlinear in the field strength. It is shown that the analyses of radiative collisions by Kramers, ter Haar, and Bates can only yield the characteristics for weak fields, integrated over the spectrum. (auth)

**13073** MULTIPHOTON DISSOCIATION OF DIATOMIC MOLECULE UNDER THE INFLUENCE OF INTENSE LASER BEAM. Devi, U.; Mohan, M. (Univ., Delhi). Phys. Lett.; 53A: No. 5, 421-422(14 Jul 1975).

Transition probability of multiphoton dissociation of diatomic molecule in an intense laser beam has been calculated using a method due to Reiss. Numerical computations are done for the case of hydrogen molecular ion. Natural units have been used here. (auth)

**13074** COMPARISON OF Mg $L_{2,3}$MM AUGER CURRENTS USING ELECTRON AND ION EXCITATION. Grant, J. T.; Hooker, M. P. (Universal Energy Systems, Inc., Dayton, Ohio, USA). Phys. Lett., A; 54: No. 2, 167-168(25 Aug 1975).

A direct comparison is made of the Mg $L_{2,3}$MM Auger currents produced by low energy electron and argon ion excitation. The ionization cross-section for the $L_{2,3}$ shell using 2 keV argon ions is estimated as $1.5 \times 10^{-18}cm^2$ per ion. (NL)

**13075** RADIATIVE AUGER EFFECT IN ION-ATOM COLLISIONS. Richard, P.; Oltjen, J.; Jamison, K. A.; Kauffman, R. L.; Woods, C. W.; Hall, J. M. (Kansas State Univ., Manhattan (USA)). Phys. Lett., A; 54: No. 2, 169-170(25 Aug 1975).

The radiative Auger effect, RAE, is observed for Al and Si bombarded by 1-2 MeV $H^+$. This is the first observation of the RAE X-ray edge using ion excitation. The K-$L_{23}L_{23}$RAE edge energy and the relative intensity are in agreement with the previously reported electron and photon induced spectra. (NL)

**13076** K-SHELL IONIZATION BY RELATIVISTIC ELECTRON IMPACT. Tawara, H. (Kyushu Univ., Fukuoka (Japan)); Ishii, K.; Morita, S.; Saito, H.; Oyamada, M. (Tohoku Univ., Sendai (Japan). Dept. of Physics); Kaji, H.; Chu, T. C. (Tohoku Univ., Sendai, (Japan). Dept of Chemistry). Phys. Lett., A; 54: No. 2, 171-173(25 Aug 1975).

The K-shell X-ray production cross sections by 70, 150, and 270 MeV electron impact have been measured and compared with available theories. The scaling laws for the K-shell ionization cross sections at relativistic energy range are discussed. (NL)

**13077** AUGER ELECTRON EMISSION SPECTRA FROM FOIL AND GAS EXCITED CARBON BEAMS. Schneider, D.; Hodge, W.; Johnson, B. M.; Smith, L. E.; Moore, C. F. (Texas Univ., Austin (USA). Center for Nuclear Studies). Phys. Lett., A; 54: No. 2, 174-176(25 Aug 1975).

Auger electron emission spectra from 2 MeV $C^+$ ions excited by collisions with thin carbon foils and Ne gas are presented. The similarity features for the $C^+ \rightarrow C$ (foil) and $C^+ \rightarrow Ne$ spectra indicates the similarity of ionization mechanisms for beam foil and gas excitation. The spectra were normalized to the lowest lying Li-like quartet state $(1s2s2p)^4Po$ in carbon by comparison with time delayed foil excited electron decay-in-flight spectra. Comparison to Hartree-Fock calculated transition energies indicates that transitions in three and four electron carbon ions dominate the prompt spectra. (NL)

**13078** EFFECTS OF FLUCTUATIONS IN ROTATIONAL TEMPERATURE, VIBRATIONAL TEMPERATURE, AND NUMBER DENSITY ON TIME AVERAGED ELECTRON BEAM MEASUREMENT OF NITROGEN ROTATIONAL TEMPERATURE. Lazdinis, S. S. Paper 75-180. New York; American Institute of Aeronautics and Astronautics (1975). 12p.

From 13th American Institute of Aeronautics and Astronautics aerospace sciences meeting; Pasadena, CA, USA (20 Jan 1975).

**13079** STUDIES OF INELASTIC MOLECULAR COLLISIONS USING IMPACT PARAMETER METHODS. III. Line Shape Functions. Fisanick-Englot, G.; Rabitz, H. (Princeton Univ., NJ). J. Chem. Phys.; 63: No. 4, 1547-1554(15 Aug 1975).

Extension of impact parameter methods within an effective Hamiltonian framework is made to yield generalized cross sections or transition rates such as those encountered in spectral line broadening. An exact impact parameter expression is derived for the diagonal elements of the generalized cross sections. Approximations to the exact impact parameter expression are discussed, and it is shown that they involve two stages: (1) approximation of the S-matrix elements and (2) replacement of a sharply peaked nonlocal impact parameter kernel by a delta function. The special case of a high-energy exponential impact parameter form is used for illustration. (auth)

**13080** AUGER SPECTRUM OF THE NOBLE GASES. II. Argon. McGuire, E. J. (Sandia Labs., Albuquerque, NM). Phys. Rev., A; 11: No. 6, 1880-1888(Jun 1975).

Theory and experiment are compared for the $L_{23}MM$ principal and satellite spectra of argon. For the principal spectrum it is shown that theory and experiment are in excellent agreement if the doublet conventionally assigned to $L_{23}$-$M_1M_1$ is reassigned to $L_{23}$-$M_1M_{23}$ ($^1P$). It is hypothesized that the splitting of the $^1P$ term is due to configuration interaction with the $(3p)^{32}D(3d)^1P$ term of $Ar^{2+}$. The reassignments enable us to locate, tentatively several unknown singlet levels in $Ar^{2+}$. An examination of the satellite spectrum confirms Mehlhorn's assignment of the terms in the $Ar^{2+}$ $(2p)^5(3s)^2(3p)^5$ configuration. The calculated satellite spectra agree with experiment in spectral shape (the location of peaks) and agree to a factor of 2 in individual satellite peak intensity. The

satellite calculations support Mehlhorn's conclusion that theory considerably overestimates the $L_1$-$L_{23}M_1$ Auger transition rate. (auth)

**13081** ELECTRON IMPACT EXCITATION OF He($n^1S$), (n = 4,5) AT INTERMEDIATE ENERGIES. Scott, T.; McDowell, M. R. C. (Royal Holloway Coll., Englefield Green, Eng.). J. Phys., B (London); 8: No. 14, 2369-2376(1 Oct 1975).

The distorted wave polarized orbital approximation is applied to the excitation of $4^1S$ and $5^1S$ levels of helium. Results are presented for total cross sections over an electron impact energy range of 25 to 400 eV and also for small-angle differential cross sections at impact energies of 50, 60, 100 and 200 eV. These are compared with experiment and the accurate Born results of previous workers. The introduction of explicit s-p coupling into the T matrix has a marked influence on the small-angle differential cross sections, producing a strong enhancement, and bringing them into close agreement with experiment at the highest energy considered. (auth)

**13082** EXPERIMENTAL-THEORETICAL COMPARISONS OF $^1S \rightarrow {}^1P$ DIFFERENTIAL MAGNETIC SUBLEVEL CROSS SECTIONS FOR ELECTRON-HELIUM SCATTERING AT 60 eV AND 80 eV. Chutjian, A.; Srivastava, S. K. (Jet Propulsion Lab., Pasadena, CA). J. Phys., B (London); 8: No. 14, 2360-2368(1 Oct 1975).

Experimental absolute differential cross sections (DCS) for the excitations $1^1S \rightarrow 2^1P$ and $2^3P$ in helium are reported at incident electron energies of 60 eV and 80 eV, and at scattering angles between 5° and 136°. By combining the present DCS measurements for the $2^1P$ excitation with results of recent electron-photon coincidence measurements, absolute DCS for the excitation of the individual magnetic sublevels $2^1P_0$ and $2^1P_{\pm1}$ are obtained from purely experimental data. These magnetic sublevel cross sections, as well as their sum, are compared with results of calculations in the multichannel eikonal, distorted-wave and first-order many-body theories. (auth)

**13083** "RESONANCES" IN POSITRON-HYDROGEN SCATTERING: EXAMPLES OF SPURIOUS RESONANCES IN THE CLOSE-COUPLING APPROXIMATION. Shimamura, I. (Tokyo Univ.). J. Phys., B (London); 8: No. 14, 2352-2359(1 Oct 1975).

The lowest two of the previously reported $e^+$-H S-wave resonances just below the n = 2 hydrogen excitation threshold are studied using the stabilization method. They are found to be artifacts of the close-coupling approximation and to disappear if the correlation effect is taken into account. The so-called anomaly-free variational methods are not free from these spurious resonances if the trial function corresponds to the 1s-2s-2p close-coupling approximation or to other approximations very similar to it. (auth)

**13084** $e^+$-He SCATTERING USING AN INTEGRAL FORM OF THE CLOSE-COUPLING APPROXIMATION. Mandal, P.; Ghosh, A. S.; Sil, N. C. (Indian Association for the Cultivation of Science, Calcutta). J. Phys., B (London); 8: No. 14, 2377-2389(1 Oct 1975).

An integral form of the close-coupling approximation as used by previous workers has been employed to investigate the processes $e^+ + He(1s^2) \rightarrow e^+ + He(1s^2)$ and $e^+ + He(1s^2) \rightarrow (e^+e^-) + He^+(1s)$. Couplings of the excited states of both the helium and positronium atoms have been neglected. Results obtained by using an approximate form of the close-coupling approximation which neglects some strong distortion effects are also presented. The results of the positronium formation cross section as reported elsewhere using the first Born approximation are found to be incorrect. The results in the two-state close-coupling approximation do not show good agreement with the experimental findings below the positronium formation threshold. The effect of exchange of electrons is found to be appreciable in the low-energy region. (auth)

**13085** OFF-SHELL EXCHANGE MATRIX ELEMENT FOR $e^-$-H SCATTERING. Ghosh, A. S. (Indian Association for the Cultivation of Science, Calcutta); Purkayastha, G. J. Phys., B (London); 8: No. 14, 2347-2351(1 Oct 1975).

The off-shell exchange matrix element of the operator $Y_{00}^{(1)}$ for the electron-hydrogen scattering problem has been evaluated analytically. This matrix element is required when one is interested in applying the form of the Lovelace-Faddeev equations due to Sloan and Moore to atomic scattering problems. (auth)

**13086** ORIENTATION AND ALIGNMENT PARAMETERS FOR THE 2p STATE OF H IN THE COULOMB-PROJECTED BORN APPROXIMATION. Morgan, L. A.; Stauffer, A. D. (Royal Holloway Coll., London). J. Phys., B (London); 8: No. 14, 2342-2346(1 Oct 1975).

The 90° optical polarization of Lyman $\alpha$ and the Fano-Macek orientation and alignment parameters of the 2p state of H have been calculated in the Coulomb projected Born approximation and its generalization. Results are presented for the polarization resulting from impact with electrons with energy in the range 40 to 200 eV. Contour maps for the rate of coincidence between scattered electrons and Lyman $\alpha$ photons emitted in the scattering plane are given for incident energies of 100 eV. (auth)

**13087** SCHWINGER VARIATIONAL PRINCIPLE IN ELECTRON-ATOM SCATTERING. Buckley, B. D.; Walters, H. R. J. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 14, 2336-2341(1 Oct 1975).

It is shown that for S-S atomic transitions the Schwinger variational principle with sufficiently flexible one-state trial functions does not take account of long-range polarization effects, even though the Schwinger formalism explicitly contains long-range terms. The plane-wave [1, 1] Padé approximant to an S → S transition in general exhibits long-range behaviour. However, since this approximant is obtained by applying the Schwinger principle to rather restricted one-state trial functions its accuracy must be called into question. (auth)

**13088** R-MATRIX THEORY OF ELECTRON-ATOM SCATTERING USING THE DIRAC HAMILTONIAN. Chang, J. J. (Queen's Univ., Belfast). J. Phys., B (London); 8: No. 14, 2327-2335(1 Oct 1975).

The R-matrix theory of electron-atom scattering using the Dirac Hamiltonian is formulated in a similar way to that used in the non-relativistic case. The expression for the R-matrix in terms of the surface amplitudes is exactly the same, but the boundary condition at r = a for the continuum orbitals is modified. The matching process at the boundary gives the K matrix, from which the S matrix and cross sections can be derived. A general computer program implementing this procedure is now being written. (auth)

**13089** ANGULAR DISTRIBUTION OF AUTOIONIZATION ELECTRONS AND SUBLEVEL POPULATION IN LOW ENERGY $He^+$-He COLLISIONS. Bordenave-Montesquieu, A.; Benoit-Cattin, P.; Gleizes, A.; Merchez, H. (Univ., Toulouse). J. Phys., B (London); 8: No. 14, L350-L354(1 Oct 1975).

A previously reported theory on the angular distribution of Auger electrons is applied to explain the angular distribution of electrons ejected by autoionization of the $2p^2\ ^1D$ state of helium, as observed in $He^+$-He collisions at 15 keV. The unequal populations of the $^1D$ magnetic sublevels are explained by a quasi-molecular excitation mechanism; the population of the sublevels $|M_L| = 1$ and $M_L = 0$ is ascribed to a rotational coupling at large internuclear distance. (auth)

**13090** TEORIYA IONIZATSII ATOMOV ELEKTRONNYM UDAROM. (Theory of Ionization of Atoms by Electron Collision). Peterkop, R. K. Riga; Izdatel'stvo Zinatne (1975). 190p.

Theories of elementary processes of ionization of atoms by electron collision are discussed. Chief attention is given to problems in which ionization theory differs from the theory of activation of discrete levels. Problems considered include: formulation of ionization theory, asymptotic form of the wave function of three or more charged particles, use of the K-harmonic method, multidimensional coulomb wave functions, integral presentations of ionization amplitudes, the role of electron exchange, and threshold behavior of ionization cross sections. Methods for calculating effective ionization cross sections are surveyed. 177 references. (tr-auth)

**13091** RECOMBINATION. Bates, D. R. (Queen's Univ., Belfast). Case Stud. At. Phys.; 4: 59-92(1975).

The main topics discussed are ionic and electronic recombination in a gas, mutual neutralization, radiative recombination, collisional-radiative recombination, dielectronic recombination, collisional-dielectronic recombination, dissociative recombination, the recombination-electrical network theorem. Attention is drawn to the great influence which the study of natural phenomena has had, and continues to have, on the investigations. (8 figs, 2 tabs, 129 refs) (auth)

**13092** EQUILIBRIUM STUDIES OF GAS PHASE ION-MOLECULE REACTIONS. Ion Cyclotron Resonance Results for the Reaction $CO_2H^+ + CH_4$ in Equilibrium $CH_5^+ + CO_2$. Staley, R. H.; Beauchamp, J. L. (Univ. of California, Los Angeles). J. Chem. Phys.; 62: No. 5, 1998-1999(1 Mar 1975).

Ion cyclotron resonance results are reported for the reaction: $CO_2H^+ + CH_4$ reversible $CH_5^+ + CO_2$, and compared with results obtained using different techniques such as following afterglow, high pressure mass spectroscopy, and trapping of ions in the space charge of an electron beam of standard mass spectrometers. The disparity of results is discussed. (GHT)

## Atomic Theory

*Refer also to abstracts 12969, 13091, 13726, and 13727.*

**13093** (ANL-Trans-980) EXPANSION IN 1/Z OF THE HARTREE-FOCK AND CORRELATION ENERGIES, RELATIVISTIC CORRECTIONS, AND DIPOLE MATRIX ELEMENT. Safronova, U. I. Translated from J. Quant. Spectrosc. Radiat. Transfer; 15: No. 3, 231-242(1975). 14p. Dep. NTIS $4.00.

Energies and dipole matrix elements have been calculated for He, Li, Be, B, C, N, O, F, and Ne-like ions in configurations 1s$^2$2s/sup n1/2p/sup n2/ (2 greater than or equal to $n_1$ greater than or equal to 0,6 greater than or equal to $n_2$ greater than or equal to 0). The Hartree-Fock energy, the correlation energy, and relativistic corrections were taken into account. Numerical results are presented for various energies and fine structures. Dipole matrix elements are required for calculation of oscillator strengths or transition probabilities. For the dipole matrix elements, two terms of the expansion of 1/Z have been obtained. Numerical results are presented. (GHT)

**13094** (CONF-750844-2) MULTIPLE EXCITATION IN FREE MOLECULES. Carlson, T. A. (Oak Ridge National Lab., Tenn. (USA)). 1975. 11p. Dep. NTIS $4.00.

From summer course in atomic physics; Carry-le-Rouet, France (31 Aug 1975).

Multiple excitation in molecules offers a number of new challenging problems that are not found in atomic systems. In particular, there is the interesting question of the nature of electron shakeup as the result of producing a localized and non-central potential. In fact, is it correct to assume that only monopole transitions occur. There is a strong need for extending fundamental studies in the general field of molecules, particularly in the area of theory. In addition, the investigation of strong shakeup satellites in complex molecules can be used to shed light on the nature of chemical bonding for these species. 21 refs, 3 tables, 3 figs. (auth)

**13095** EXTENDED HUECKEL CALCULATION OF REPULSIVE INTERACTIONS IN NOBEL GASES. Hathaway, K. B.; Krumhansl, J. A. (Cornell Univ., Ithaca, NY). J. Chem. Phys.; 63: No. 10, 4308-4312(15 Nov 1975).

Repulsive potential energies for all of the possible pairs of atoms of the noble gases helium, neon, and argon are calculated by the semiempirical extended Hueckel molecular orbital method. The agreement of the calculated energies with other theoretical results is significantly improved by computing overlaps using analytic approximations to the atomic Hartree-Fock atomic orbitals instead of the more commonly used Slater functions. (auth)

**13096** SHORT-RANGE CORRELATIONS AND THE STRUCTURE FACTOR AND MOMENTUM DISTRIBUTION OF ELECTRONS. Kimball, J. C. (Louisiana State Univ., Baton Rouge). J. Phys., A (London); 8: No. 9, 1513-1517(Sep 1975).

It is shown that for any system of nonrelativistic electrons and nuclei the large wave vector limit of the probability of finding an electron with momentum hk is proportional to $1/k^8$, and the electronic structure factor is proportional to $1/k^4$. Furthermore, the coefficient of the $1/k^4$ term in the structure factor is proportional to the zero separation electron–electron correlation. The coefficient of the $1/k^8$ term in the momentum distribution is proportional to the sum of zero-range electron–electron and electron-nuclear correlations. (auth)

**13097** ADDENDUM TO "EFFECTS OF RETARDATION ON ELECTROMAGNETIC SELF-ENERGY OF ATOMIC STATES." Au, C. K. (Yale Univ., New Haven); Feinberg, G. Phys. Rev., A; 12: No. 4, 1722(Oct 1975).

Electromagnetic self-energy shifts for the 2S states of hydrogenic ions for Z equals 10, 20, 30, 40, 50, 60, and 70 are presented. The results are computed nonrelativistically and with retardation according to a recent prescription of ours. (auth)

**13098** SOLUTION OF THE SCHROEDINGER EQUATION FOR THE HYDROGEN ATOM USING A MODULAR ANALOGUE COMPUTING SYSTEM. Summers, M. K. (Worcester Coll. of Education, Eng.). Phys. Educ.; 19: No. 6, 424-429(Sep 1975).

An alternative to the use of a series of film loops to illustrate, for teaching purposes, digitally computed solutions of the time independent Schroedinger equation for the hydrogen atom is an analogue technique which is described here. The determination of eigenfunctions and energy levels of the hydrogen atom, together with a brief comparison of hydrogen with the singly ionized helium atom by the method are illustrated. (UK)

**13099** OPTIMIZATION OF LOCAL LINEAR RESPONSE CALCULATIONS OF ATOMIC PROPERTIES. Ahlberg, R.; Goscinski, O. (Univ., Uppsala). J. Phys., B (London); 8: No. 13, 2149-2159(11 Sep 1975).

It is shown that several relationships valid for exact or variational-perturbation theories hold also, under quite general conditions, for much simpler (local potential) theories based on variations of an ad hoc functional. Equations of motion, formulae for the f-sum rule, frequency-dependent polarizability- and shielding-tensors are derived. Scaling procedures are discussed. Numerical examples, with a Slater exchange potential, are given. It is shown that the use of a cut-off potential, as in previous calculations, is detrimental to the optimization procedure. (auth)

**13100** RELATIVISTIC POTENTIAL EXPRESSIONS IN OPEN-SHELL SCF CALCULATIONS. Andriessen, J.; Ormondt, D. V. (Technische Hogeschule, Delft, Netherlands). J. Phys., B (London); 8: No. 12, 1993-1998(21 Aug 1975).

It is shown that in relativistic SCF calculations for atomic systems with open shells close to LS coupling it is often desirable to construct the potential expressions for the orbital wavefunctions on the basis of a relativistically formulated LS term. Especially if one considers differences between one-electron properties calculated for the $j = l \pm \frac{1}{2}$ functions of the open shell, the commonly used averaging techniques often lead to exaggerated relativistic effects. (auth)

**13101** DECOUPLED HARTREE–FOCK METHODS. III. An Analysis for $H_2$, $Li_2$, and LiH. Naray-Szabo, G. (Univ., Goettingen, Ger.). Acta Phys. Acad. Sci. Hung.; 38: No. 3, 233-242(1975).

The decoupled Hartree–Fock approximation is analyzed in detail. The Hartree–Fock energy expression is used as starting point. Expansion on a subminimal basis and the Zero Diatomic Differential Overlap approximation are introduced. The effect of these simplifications is examined in the case of the $H_2$ molecule. Various energy minimization procedures are used to reduce computational work. Good agreement with the exact HF results in case of total energies was obtained. The accuracy in the case of ionization potentials, and equilibrium distances can be called fair. (auth)

**13102** AN APPROXIMATE VARIATIONAL PERTURBATION METHOD. Cullen, J.; Zerner, M. C. (Guelph Univ., Ontaria (Canada)). Chem. Phys. Lett.; 34: No. 3, 591-593(1 Aug 1975).

The Goldhammer-Feenberg variational procedure is applied to the perturbation treatment of the configuration interaction matrix of Diner, Malrieu and Claverie (PCILO) to yield a scheme (PVCILO) that appears more accurate for the small systems investigated. In addition, PVCILO shows promise as executing as an $N^2$ method, where N is the number of basis bonds. (auth)

**13103** MARCINKIEWICZ'S THEOREM AND APPROXIMATION SCHEMES FOR MANY-PARTICLE CORRELATION FUNCTIONS: COMMENT ON A PAPER BY RAJAGOPAL AND SUDARSHAN. Titulaer, U. M. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., A; 11: No. 6, 2204-2208(Jun 1975).

Recently Rajagopal and Sudarshan proposed a generalization of Marcinkiewicz's theorem to quantum systems. From it they conclude that approximation schemes, such that the irreducible equal-time correlation functions vanish for all orders larger than l but are nonvanishing for some l larger than 2, are inconsistent with basic positivity conditions on the density operator. We show that this statement is false for fermion systems. For boson systems the statement is correct and its extension to irreducible correlation functions for unequal times can be made plausible, a fully rigorous proof does not yet seem available, however. The possibility is briefly discussed that an extension of Marcinkiewicz's theorem may hold for fermion systems, provided one confines his attention to equilibrium states of such systems. (auth)

**13104** THEORY OF THE (e,2e) REACTION ON MOLECULES. McCarthy, I. E. (Flinders Univ. of South Australia, Bedford Park). J. Phys., B (London); 8: No. 12, 2133-2139(21 Aug 1975).

The theory of (e, 2e) reactions given in a previous publication is modified in the light of experience with fitting data for atoms and molecules. The molecular orbitals are linear combinations of atomic orbitals in spherical polar coordinates. The general formulation is greatly simplified by using closure over unresolved rotational and vibrational states. Concrete examples of interest are formulated and discussed. (auth)

**13105** PROJECTED GENERAL SPIN-ORBITAL WAVEFUNCTIONS FOR THREE-ELECTRON SYSTEMS. Beebe, N. H. F. (Univ. of Florida, Gainesville); Lunell, S. J. Phys., B (London); 8: No. 14, 2320-2326(1 Oct 1975).

Spin-projected Hartree-Fock calculations using general spin orbitals are performed on some S, P, D and F states of Li, and on the ground states of its isoelectronic ions with Z = 4 to 10. The energy −7.447596 au is obtained for Li $2^2$S, compared to −7.447565 au with the spin-optimized SCF method and −7.432727 au with the ordinary restricted Hartree–Fock method. Full configuration-interaction results for the same basic sets are also reported. (auth)

# PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

*Refer also to abstracts 11913, 11914, and 13120.*

**13106** (AECL-5226, pp 43-44) OBSERVATION OF SOUND WAVES, ENTROPY FLUCTUATIONS, AND THE TRANSITION FROM FIRST TO ZERO SOUND IN LIQUID HELIUM. Woods, A. D. B.; Svensson, E. C.; Martel, P. Aug 1975.
In Physics Division progress report, April 1-June 30, 1975.

**13107** (INIS-mf-1807) GENERALIZED HYDRODYNAMICS FOR THE DIFFUSION PROCESS. de Schepper, I. (Katholieke Universiteit Nijmegen (Netherlands)). 1974. 221p. INIS.
The self-diffusion process is studied theoretically by means of a function $G(\vec{r},t)$, which is the probability of finding a tagged particle at time t at the position $\vec{r}$. The hydrodynamic equation used is Fick's law, which is derived and extended. Kinetic theory of hard spheres at low densities and mode coupling theory are employed. It is shown from kinetic theory that the super Burnett coefficient does not exist both in two and three dimensions. (INIS)

**13108** COMPRESSIBILITY HYPOTHESES IN RELATIVISTIC FLUIDS. Lucquiaud, J. C. pp 347-351 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974). (In French)
From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).
The first part of this article sums up a demonstration of the compressibility hypotheses for relativistic fluids introduced by A. Lichnerowicz. In part two it is shown how the calculation led to a new development of Juttner's formulae. In the particular case of a Maxwell-Boltzmann fluid, polynomials similar to those of Marle are obtained, generated by a differential operator invariant homogeneons space. (FR)

**13109** HYDRODYNAMICS OF NUCLEAR SPINS IN ANISOTROPIC SUPERFLUID HELIUM 3. Seiden, J. (Paris-11 Univ., 91-Orsay (France). Inst. d'Electronique Fondamentale). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 14, 429-432(14 Apr 1975). (In French)
The hydrodynamical equations of spin motion in a monodomain of phase AMB of superfluid helium 3 are derived and certain physical consequences of these equations are discussed. (FR)

**13110** WEAK AMPLITUDE HYDRODYNAMICAL MOTIONS OF A MONODOMAIN IN ANISOTROPIC SUPERFLUID HELIUM THREE. Seiden, J. (Paris-11 Univ., 91-Orsay (France). Inst. d'Electronique Fondamentale). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 12, 353-356(24 Mar 1975). (In French)
The hydrodynamical equations for weak amplitude motions of a monodomain in phase A of superfluid helium three are derived. Effects of temperature gradients are included, but the presence of the spins is neglected. (FR)

**13111** RELATIVISTIC MAGNETOHYDRODYNAMICS ACCORDING TO G. F. R. ELLIS. Bray, M. C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 12, 837-839(24 Mar 1975). (In French)
Stream-lines and h-trajectories in magnetohydrodynamics are studied using the G. F. R. Ellis' method. (FR)

**13112** PHASE DIAGRAM AND MAGNETIC SUSCEPTIBILITY OF SUPERFLUID $^3$He. Oestgaard, E. (Trondheim Univ. (Norway). Institutt for Fysikk). Phys. Lett., A; 54: No. 1, 39-41 (11 Aug 1975).
The critical temperature for superfluidity in liquid $^3$He is calculated or estimated as function of Fermi momentum, giving a corresponding phase diagram. In the calculations reaction-matrix elements are obtained by a modified Brueckner theory, giving superfluidity corresponding to F-state pairing in the A phase. The zero-temperature limit for the susceptibility ratio $\chi B/\chi F$ in in the B phase is also estimated from the Landau Fermi-liquid parameters $Z_0$ and $Z_2$. (auth)

**13113** NMR IN SUPERFLUID $^3$He: HYDRODYNAMIC SHIFTS. Fetter, A. L. (Stanford Univ., Calif. (USA). Inst. of Theoretical Physics). Phys. Lett., A; 54: No. 1, 63-65(11 Aug 1975).
Hydrodynamic shifts in the magnetic resonance frequencies of superfluid $^3$He near $T_c$ are evaluated with Legget's theory. Observable shifts are predicted, except for flow perpendicular and parallel to the static magnetic fields in the A and B phases, respectively. (auth)

**13114** A CONTRIBUTION TO THE EFFICIENT SOLUTION OF EXTENSIVE SYMBOLIC COMPUTATIONS. Kerner, W.; Steuerwald, J. (Max-Planck-Institut fuer Plasmaphysik, Garching; Muenchen (F. R. Germany)). Comput. Phys. Commun.; 9: No. 6, 337-349(Jun 1975).
The solving of extensive algebraic problems with computers is difficult owing to the large amount of storage and computing time needed. A method is described that obviates these difficulties in many cases by using appropriate operators instead of extensive polynomials. This calculation is prompted by the question whether a class of algebraic equilibria in plasma physics governed by magneto-hydrodynamic theory is stable. Great accuracy is called for in treating this problem. The calculation of a three-dimensional integral containing Fourier, Taylor and trigonometric series is described. (auth)

**13115** MEAN ENERGY OF A DECAYING MAGNETIC FIELD IN MHD-TURBULENCE. Braeuer, H.; Krause, F. (Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Astrophysik). Astron. Nachr.; 295: No. 5, 223-228(1974).
The decay time of the mean energy of the fluctuating part of the magnetic field—in contrast with the energy of the mean field—is shown to be determined by the molecular magnetic diffusivity and the correlation length of the turbulence. The investigation is carried out for weak magnetic fields in homogenous isotropic mirror-symmetric turbulence and in the framework of the second-order correlations approximation. (INIS)

**13116** SIMPLE MODEL FOR THE KAPITZA CONDUCTANCE. Sluckin, T. J. (Univ. of Nottingham, Eng.). Phys. Lett.; 53A: No. 5, 390-392(14 Jul 1975).
A simple model is suggested which views the Kapitza resistance in terms of individual atomic collisions at a solid-HeII boundary. (1 figure) (auth)

**13117** TRANSPORT PROPERTIES OF THE A PHASE OF SUPERFLUID $^3$He AT LOW TEMPERATURES. Valls, O.; Houghton, A. (Brown Univ., Providence, R. I. (USA). Dept. of Physics). Phys. Lett., A; 54: No. 2, 143-144(25 Aug 1975).
The results of a calculation of transport properties of the A phase of superfluid $^3$He are reported. The temperature dependence of the normal fluid density viscosity, thermal conductivity, and nuclear spin relaxation time are given. (NL)

**13118** VORTICES IN He II, CURRENT ALGEBRAS AND QUANTUM KNOTS. Rasetti, M.; Regge, T. (Institute for Advanced Study, Princeton, N. J. (USA)). Physica; 80: No. 3, 217-233(1975).
A canonical quantization scheme is developed for vortices in superfluid He II, using Dirac's technique for constrained hamiltonian systems. Quantization introduces in the theory in a natural way the structure of the infinite Lie algebra of incompressible flows. It is argued that all the topological invariants of the vortex, considered as a knot, can be regarded as observables of the system. Finally unitary representations of measure preserving flows on $R^3$ and current algebra are discussed. (NL)

**13119** ELLIPSOMETRIC STUDIES OF EVAPORATION AND CONDENSATION OF THE HELIUM FILM. Blair, D. G.; Matheson, C. C. (East Anglia Univ. (UK). School of Mathematics and Physics). Physica; 80: No. 5-6, 541-549(Nov 1975).
Measurements have been made of the behavior of the helium film when it is isolated from the bath. The film is measured optically (using an automatic ellipsometer) on a magnetically leviated substrate. Spontaneous evaporation is observed due to the extreme sensitivity of the film to small changes in thermal equilibrium. However, contrary to expectations the evaporation rate is observed to increase as the film thickness decreases. (NL)

**13120** GAP—A PIC-TYPE FLUID CODE. Marder, B. M. (Los Alamos Scientific Lab., NM). Math. Comput.; 29: No. 130, 434-446(Apr 1975).
GAP, a PIC-type fluid code for computing compressible flows, is described and demonstrated. While retaining some features of PIC, it is felt that the GAP approach is conceptually and operationally simpler. 9 figures. (auth)

# PHYSICS (HIGH-ENERGY)

**13121** SPS EXPERIMENTAL PROGRAM. Fidecaro, M. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 191-218 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The experimental program at the SPS is reviewed as it takes shape from the proposals put forward up to this spring. (FR)

## Particle Interactions and Properties (Experimental)

*Refer also to abstracts 12773, 13258, and 13454.*

**13122** (JINF-P1, 2-8529, pp 73-96) HIGH ENERGY PHYSICS AND COSMIC RADIATION (FUTURE STUDIES). Vernov, S. N.; Feinberg, E. L. (Moscow State Univ.). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

An outline is given of the properties of cosmic radiation that require study in the future and possible techniques and installations for studying them. These are primarily installations to be placed on board artificial satellites. (JSR)

**13123** (JINR-P1, 2-8529, pp 167-176) REPRESENTATIONS OF EXPERIMENTAL DATA ON ANALYTICAL FUNCTIONS. Dumbrais, O. V. (Moscow State Univ.). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

A review is given of research on the description of experimental data by analytical functions. (62 references) (JSR)

**13124** MULTIPARTICLE PRODUCTION PROCESSES AT HIGH ENERGY. Berger, E. L. (CERN, Geneva). pp 556-671 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

Lectures are presented in which an attempt is made to examine critically new data and corresponding theoretical developments in multiparticle production processes at high energy. Restriction is made to recent progress and an inclusive approach to multiparticle physics. Also covered are short-range order and single-particle spectra, two explicit models, inclusive correlations, and inelastic diffraction scattering. (JFP)

**13125** RECENT RESULTS ON MESON RESONANCES AND POSSIBLE EXPERIMENTS AT HIGH ENERGY. Miller, D. H. (Purdue Univ., Lafayette, Ind. (USA)). pp 161-170 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The study of exclusive channels at high energies may be as important as it was at lower energies. As an example current problems in Meson Spectroscopy are reviewed and experiments are suggested for higher energies. (FR)

**13126** SEARCH FOR 1/3 e QUARKS IN COSMIC RAYS WITH THE LEEDS CLOUD CHAMBER. Hazen, W. E.; Hodson, A. L.; Green, B. R.; Kass, J. R. (Leeds Univ. (UK)); Winterstein, D. F.; Keller, O. A. (Michigan Univ., Ann Arbor (USA)). Nucl. Phys., B; 95: No. 2, 189-196(1 Sep 1975).

The central regions of cosmic-ray air showers near sea level have been studied with the Leeds cloud chamber for the possible occurence of low-ionizing tracks. The average energy of the primary particles was a few times $10^6$ GeV. The current results give an upper limit to the "flux" of $\frac{1}{3}$e quarks of $1.2 \times 10^{-11}$cm$^{-2}$ sec$^{-1}$ at a 90% confidence level. A simple model is used to obtain an upper limit to the production cross section versus quark mass. (auth)

**13127** HIGH ENERGY PHYSICS INDEX. Volume 13, No. 14, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 113p.

**13128** HIGH ENERGY PHYSICS INDEX. Volume 13, No. 20, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 125p.

**13129** HIGH ENERGY PHYSICS INDEX. Volume 13, No. 21, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 120p.

**13130** HIGH ENERGY PHYSICS INDEX. Volume 13, No. 22, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 120p.

**13131** HIGH ENERGY PHYSICS INDEX. Volume 13, No. 23, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 116p.

### Electromagnetic

*Refer also to abstract 12946.*

**13132** (ISN-TS-74-6) EMISSION OF TWO PHOTONS DURING NEUTRON-PROTON RADIATIVE CAPTURE. Guet, C. (Grenoble-1 Univ., 38 (France)). 1974. 69p. (In French). Dep. NTIS (US Sales Only) $5.50.

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble, France.

Total and differential cross sections for two-photon emission in $n + p \rightarrow d + 2\gamma$ interactions at 2.22 MeV are found. (JFP)

**13133** (RL-75-106) MEASUREMENT OF THE ELECTROMAGNETIC FORM FACTOR OF THE $\eta$ MESON AND OF THE BRANCHING RATIO FOR THE $\eta$ DALITZ. Jane, M. R.; Grannis, P.; Jones, B. D.; Bellamy, E. H.; Green, M. G.; Kirkby, J. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). 26 Oct 1975. 6p. (RPP/H-148). Dep. NTIS (US Sales Only) $4.50.

In an optical spark chamber experiment a sample was obtained of 80 $\eta$ Dalitz decays ($\eta \rightarrow e^+e^-\gamma$) and the $\eta$ electromagnetic form factor was measured to be $F(X) = 1.0-(0.22 \pm 0.45)X$, where $X = M^2_{ee}/M^2_\eta$, and the branching ratio ($\eta \rightarrow e^+e^-\gamma/\eta \rightarrow \pi^+\pi^-\pi^0$) = $(0.0082 \pm 0.0020)$. (auth)

**13134** SPIN TESTS FROM PARTICLE DECAYS. Minnaert, P. (Univ., Bordeaux). pp 415-476 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

A review is given of the basic tools for spin test from particle decays including polarization, observables in single and sequential decays, and usual one- and two-amplitude decays. The review of spin tests covers spin tests from positivity and rank conditions, from comparison of two decay modes, and from angular correlations. (JFP)

**13135** REMARKS ON $e^+e^-$ ANNIHILATION. Llewellyn-Smith, C. H. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 161-179 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The main features of the recent data obtained for $e^+e^-$ annihilation are discussed. Stress is put upon two items especially. $R = \sigma(e^+e^- \rightarrow \text{Had})/\sigma(e^+e^- \rightarrow \mu^+\mu^-)$ rises from about 2 or 3 at E(c.m). = 3 GeV up to between 4 and 7 at 5 GeV; correspondingly, $\sigma(e^+e^- \rightarrow \text{Had})$ is about $22 \pm 5$nb throughout this range. The data for $e^+e^- \rightarrow H(p) + \ldots$ is consistent with the hypothesis that $s(d\sigma/dx)$ scales (i.e., is a function of x only) for $x > \frac{1}{2}$, where $x = 2p\sqrt{s}$. For $x < \frac{1}{2}$ there is a strong s-dependence (the data being nowhere compatible with the hypothesis that $1/\sigma(d\sigma/dx)$ scales). (FR)

**13136** WHAT DO WE LEARN FROM DEEP INELASTIC SCATTERING WITH POLARIZED TARGETS. Hey, A. J. G. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 267-283 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The kinematics and theoretical predictions for inelastic lepton-proton scattering off polarized targets are briefly reviewed.

The Bjorken limit of this process provides stringent tests of parton and light cone ideas while the Regge limit exposes some of the more obscure parts of J plane folklore. (FR)

**13137** THE HIGH-ENERGY INVERSE BREMSSTRAHLUNG PROCESS AND SELF-ACCELERATION OF HIGH-DENSITY ELECTRON BEAMS CROSSING A TARGET. Diambrini-Palazzi, G. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 57: No. 5, 491-493(4 Aug 1975).

Attention is called to the existence of a kind of high-energy inverse bremsstrahlung process which can be described as follows. A real electron e (momentum $\bar{p}_0$, energy $E_0$) absorbs a real photon $\gamma$ (momentum $\bar{k}$, energy K). The virtual electron e' interacts with a nucleus N and the energy momentum conservation is restored. In the final state there is a real electron e with momentum $\bar{p}$, energy E, and recoiling nucleus with momentum $\bar{q}$ and energy $\epsilon$. The amplitude and kinematics of the process look like those of the bremsstrahlung case. (auth)

**13138** MEASUREMENT OF THE $\gamma$-V COUPLING CONSTANTS AND $\sigma_T$(Vd) FROM COHERENT $\gamma$-d INTERACTIONS AT 7.5 GeV. Alexander, G.; Benary, O.; Gandsman, J.; Lissauer, D.; Levy, A.; Oren, Y.; Rosenstein, L. M. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy). Phys. Lett., B; 57: No. 5, 487-490 (4 Aug 1975).

The total and differential cross sections for coherently photoproduced $\rho$, $\omega$ and $\rho'$ on deuterium at 7.5 GeV have been measured. Using VDM relations, the values $\gamma_\omega^2/\gamma_\rho^2 = 7.1 \pm 1.5$, $\sigma_T(\rho d) = (54 \pm 2)$ mb and $\sigma_T(\omega d) = (56 \pm 5)$ mb have been obtained. Assuming the amplitude for $\rho'$ production via an intermediate $\rho^0$ to be small and that the amplitudes for $\rho p$ and $\rho' p$ elastic scattering are comparable, $\gamma_{\rho'}^2/\gamma_\rho^2 = 6.0 \pm 1.2$ and $\sigma_T(\rho' d) = (47 \pm 6)$ mb were found. (auth)

**13139** PRODUCTION OF HYPERONS BY VIRTUAL PHOTONS. Azemoon, T.; Dammann, I.; Driver, E.; Lueke, D.; Specht, G. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R Germany)); Heinloth, K.; (Bonn Univ. (F. R. Germany)); Ackermann, H.; Ganssauge, E. (Marburg Univ. (F. R. Germany)); Janata, F. Nucl. Phys., B; 95: No. 1, 77-97(25 Aug 1975).

The electroproduction of $K^+Y$ on protons, $ep \rightarrow eK^+Y$, ($Y \equiv \Lambda$; $\Sigma^0$; $\Sigma'^0(1385)$; $\Lambda'(1405; \Lambda'(1520)$) was investigated by measuring the scattered electron and the produced $K^+$ meson in coincidence. The differential cross sections were determined as functions of W, $q^2$, t and $\phi K\gamma$ in the kinematical region: $1.9 \leq W \leq 2.8$ GeV, $-0.10 > q^2 > -0.60$ GeV$^2$/c$^2$, $t_{min} > t > t_{max}$ $-0.33$ GeV$^2$/c$^2$, $0 \leq \phi K\gamma \leq 360^0$. (auth)

**13140** POLARIZATION BREAK-UP OF ANTIDEUTERONS IN THE NUCLEAR COULOMB FIELD. Ericson, T. E. O. (European Organization for Nuclear Research, Geneva (Switzerland)); Osland, P. (Trondheim Univ. (Norway). Institutt for Fysikk). Nucl. Phys., A; 249: No. 3, 445-456(22 Sep 1975).

Antideuterons cascading down through high Bohr orbits around nuclei are considered. For heavy nuclei ($Z \gtrsim 30$-40) it is found that they will become torn apart by the polarization before they come close enough to the nucleus to get absorbed. In the last couple of orbits before break-up, the polarization shift will be of the order of $1:10^3$. (NL)

**13141** EVIDENCE FOR $J^{PC} = 4^{2+}$ FOR THE S(1930) MESON FROM $\bar{p}p$ BACKWARD ELASTIC SCATTERING. D'Andlau, C.; Cohen-Ganouna, J.; Laloum, M.; Lutz, P. (College de France, 75-Paris); Petri, C. (Pisa Univ. (Italy). Istituto di Fisica). Phys. Lett., B; 58: No. 2, 223-227(1 Sep 1975).

Partial results of the analysis of an $\bar{p}p$ backward elastic scattering experiment are reported between 175 and 750 MeV/c. Various evidences are given of the resonant nature of a backward peak at the S-meson mass. Analysis leads to $J^{PC} = 4^{2+}$, firmly connected to other experimental data with $I^G = 1^-$. All results agree for an assignment to the $A_2$ trajectory. (NL)

**13142** MEASUREMENT OF DIFFERENTIAL CROSS SECTIONS FOR ANTIPROTON-PROTON ANNIHILATION INTO CHARGED PION AND KAON PAIRS BETWEEN 0.79 AND 2.43 GeV/c. Eisenhandler, E.; Gibson, W. R.; Hojvat, C.; Kalmus, P. I. P.; Lee, L. C. Y.; Pritchard, T. W.; Usher, E. C.; Williams, D. T. (Queen Mary Coll., London (UK)); Harrison, M. A.; Range, W. H. (Liverpool Univ. (UK)). Nucl. Phys., B; 96: No. 1. 109-154(15 Sep 1975).

Differential cross sections have been measured for the interactions $\bar{p}p \rightarrow \pi^-\pi^+$ and $\bar{p}p \rightarrow K^-K^+$ over a center of mass angular range $-0.95 \leq \cos\theta^* \leq 0.95$ at 20 incident momenta between 0.79 and 2.43 GeV/c. A magnetic spectrometer with wire spark chambers was used. Typically 2000 $\pi^-\pi^+$ and 300 $K^-K^+$ events were obtained at each momentum. Results are compared with those from related experiments. (NL)

## Weak

**13143** (BNL-20544) RECENT RESULTS FROM THE BROOKHAVEN NATIONAL LABORATORY 7' BUBBLE CHAMBER. Cazzoli, E. G.; Cnops, A. M.; Connolly, P. L.; Murtagh, M. J.; Palmer, R. B.; Samios, N. P.; Tso, T. T.; Williams, H. H. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 19p. (CONF-750855-13). Dep. NTIS $4.50.

From international symposium on lepton and photon interactions at high energies; Stanford, California, USA (21 Aug 1975).

In this presentation the equipment is briefly described and the method of analysis used for all events is reviewed. New results are then presented on the ratio of neutrino cross sections on neutrons to that on protons. One is reminded of the published event indicating an apparent DELTA S equals -DELTA Q current. Finally, the parameters of all the other charged current events containing at least one strange particle are presented. (auth)

**13144** (LAL-1276) EXPERIMENTAL DETERMINATION OF THE DIFFERENTIAL CROSS SECTIONS OF $\nu_\mu$ AND $\bar{\nu}_\mu$ INTERACTIONS. Lutz, A. M. (Paris-11 Univ., 91- Orsay (France)). May 1975. 185p. (In French). Dep. NTIS (US Sales Only) $8.50.

Thesis.

Experimental results obtained in a study of $\nu_\mu$ and $\bar{\nu}_\mu$ interactions with the heavy bubble chamber at CERN filled with $CF_3Br$ were reported. The most significant results were the proof of $\nu$ interactions of the neutral current type, measurement of the total interaction cross sections for $\nu_\mu$, $\bar{\nu}_\mu$, $\nu_e$, and $\bar{\nu}_e$, and observation of the quasi-elastic production of hyperons ($\Lambda^*$) by $\bar{\nu}_p$. The experimental difficulties encountered and the methods used to overcome them or compensate for them were discussed in detail. The differential cross sections of $\nu_\mu$ and $\bar{\nu}_\mu$ were determined. These results were placed in the framework of the parton model, one of whose implications is defining the scaling behavior. The results obtained are interpreted in terms of nucleon structure. (JSR)

**13145** THEORETICAL INTERPRETATION OF NEUTRINO EXPERIMENTS. Paschos, E. A. (National Accelerator Lab., Batavia, IL). pp 812-836 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

The discussion of neutrino experiments covers deep inelastic scattering, scaling for weak structure functions implying linear rise of total cross sections and providing bounds for antiparticle-particle total cross section ratios. Also a survey is given of existing results on neutral currents within the context of gauge models of leptonic and semileptonic interactions. (JFP)

**13146** MUON-PROTON AND NUON-NUCLEUS SCATTERING. Melissinos, A. C. (Univ. of Rochester, NY). pp 874-898 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

Preliminary results are given of an extensive program of muon scattering experiments are reported. Included are $\mu$-e universality, excited leptons, heavy nuclei, and the distribution of hadrons produced in $\mu$-p deep inelastic collisions. (JFP)

**13147** NEUTRAL CURRENTS IN GARGAMELLE. Kluberg, L. (Ecole Polytechnique, 75-Paris (France). Lab. de Physique des Hautes Energies). pp 111-124 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The latest status of the research of neutral currents in Gargamelle bubble chamber (experiment still going on) is presented. The latest data from each of the seven laboratories of the so-called Gargamelle collaboration were collected. Some rough calculations were effected by the author himself, so the approximative value given for the leptonic neutral currents do not bind the collaboration. (FR)

**13148** TESTS OF SCALE INVARIANCE IN THE GARGAMELLE NEUTRINO-EXPERIMENT. Degrange, B. (Ecole Polytechnique, 75-Paris (France). Lab. de Physique des Hautes Energies). pp 51-74 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The neutrino experiment performed with the CERN neutrino/antineutrino beam in the large heavy liquid bubble chamber Gar-

gamelle yielded results in agreement with scale invariance predictions in the energy range 1-10 GeV. The signification of this precocious scaling is analyzed here, through the study of the distributions of the scaling variables $x' = q^2/(2M\nu + M^2)$, and of the variable $y = \nu/E$, in a sample of 2600 neutrino events and 1000 antineutrino events. (FR)

**13149** NEUTRAL CURRENTS IN GARGAMELLE. Lagarrigue, A. (Laboratoire de l'Accelerateur Lineaire, Orsay, France). pp 543-559 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The reactions $\bar{\nu}_\mu + e^- \rightarrow J_\mu + e^-$ and $\nu_\mu + N \rightarrow \nu_\mu +$ hadrons are studied. Three independent arguments are given to show that the neutral current events cannot be due in their large majority to the known neutral interacting particles which constitute the background. The value of the $\sin^2 \theta_w = 0.39 \pm 0.05$ was found. (JFP)

**13150** CALTECH–FERMILAB NEUTRAL CURRENT SEARCH. Barish, B. C. (California Inst. of Tech., Pasadena). pp 561-565 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). CONF-740731-.

The question of the existence or nonexistence of neutral currents at or near the reported levels in the inclusive reactions nu(anti nu) + N yields nu(anti nu) + hadrons was studied. Evidence was found for neutrino-like interactions with no muon in the final state. These results are consistent with previous results and seem to point to the existence of neutral currents as an explanation. (JFP)

**13151** STUDY OF SINGLE PION PRODUCTION BY NEUTRAL CURRENTS. Derrick, M. (Argonne National Lab., IL). pp 567-574 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

Using hydrogen and deuterium fills of the 12-ft bubble chamber, events were observed of the single pion production reactions nu p yields nu n $pi^+$, nu p yields nu p $pi^0$, and nu n yields nu p $pi^-$. The neutral currents are compared to those of the charged-current reaction nu p yields $mu^-$ p $pi^+$. All sources of possible background that could simulate the neutral current events are measured and so accounted for. In particular, the neutron background from reactions such as np yields nn $pi^+$, which is completely determined, allows a detailed comparison with models of the neutral current process. The p $pi^-$ mass spectrum shows no enhancement at the DELTA(1236) mass. (auth)

**13152** HIGH-STATISTICS DETERMINATION OF THE Λ MEAN LIFETIME. Clayton, E. F.; Bacon, T. C.; Butterworth, I.; Wateis, R. M. (Imperial Coll. of Science and Technology, London (UK)); Conforto, B.; Gopal, G. P.; Kalmus, G. E.; Ross, R. T.; van Horn, A. J. (Science Research Council, Chilton (UK). Rutherford Lab.). Nucl. Phys., B; 95: No. 1, 130-134 (25 Aug 1975).

Recent determinations of the mean lifetime of the Λ hyperon have given values significantly greater than the previously accepted world average. Using 34,000 $\Lambda \rightarrow p\pi^-$ decays in the CERN 2m. hydrogen bubble chamber, the lifetime has been measured to be $(2.611 \pm 0.020) \times 10^{-10}$ sec. (auth)

**13153** ANOMALOUS MAGNETIC MOMENT OF THE MUON. Farley, F. J. M. (Royal Military Coll. of Sciences, Shrivenham, Eng.). Contemp. Phys.; 16: No. 5, 413-441(Sep 1975).

A historical survey is given of the measurements of the gyromagnetic ratio g of the muon. A brief introduction is given to the theory of the "anomalous magnetic moment" $a \equiv \frac{1}{2}(g-2)$ and its significance is explained. The main part of the review concerns the successive $(g-2)$ experiments to measure a directly, with gradually increasing accuracy. At present experiment and theory agree to $(13 \pm 29)$ parts in $10^9$ in g, and the muon still obeys the rules of quantum electrodynamics for a structureless point charge. (auth)

**13154** BRANCHING RATIOS OF THE $f^0$ MESON. Emms, M. J.; Kinson, J. B.; Stacey, B. J.; Votruba, M. F.; Woodworth, P. L. (Birmingham Univ. (UK)); Bell, I. G.; Dale, M.; Major, J. V. (Durham Univ. (UK)); Charlesworth, J. A.; Crennell, D. J. Nucl. Phys., B; 96: No. 1, 155-166(15 Sep 1975).

Branching ratios have been determined for the $f^0$ meson produced in 4 GeV/c $\pi^+$d interactions. The decay rates to $2\pi^+2\pi^-$ and $K\bar{K}$ are $2.4 \pm 0.6\%$ and $2.5 \pm 1.5\%$ respectively, both relative to the $\pi\pi$ mode. Upper limits are given for the decays to $\eta\pi^+\pi^-$, $\eta\eta$ and $K^+\pi^+K^0$. (NL)

## *Strong (Baryon-induced)*

*Refer also to abstracts 13329 and 13404.*

**13155** (FERMILAB-Conf-75/76-THY) DEVELOPMENTS IN STRONG INTERACTION PHYSICS. Quigg, C. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Sep 1975. 33p. (CONF-750858-15). Dep. NTIS $4.00.

From meeting of the ASP division of particles and fields; Seattle, Washington, USA (27 Aug 1975).

Some recent results on high energy collisions are reviewed. Regularities of total and elastic cross sections are summarized in light of theoretical ideas. New indications of the structure of events with large transverse momentum particles receive brief attention. The general features of nondiffractive particle production are emphasized. (auth)

**13156** (JINR-P1, 2-8529, pp 397-456) HIGH ENERGY HADRONS IN COSMIC RADIATION. Murzin, V. S.; Sarycheva, L. I. (Moscow State Univ.). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The theme is to examine what experiments on cosmic radiation in the energy range above $10^3$ GeV has given and can contribute to knowledge in high energy physics. The properties of hadron-nuclei collisions are also examined. In the first part the energy dependence is examined with a discussion of the measurement of the inelastic interaction cross section in cosmic radiation, scaling, scaling in the central and fragmentation regions, direct studies of the fragmentation region, interactions of pions with nuclei, new particles in cosmic radiation, and unusual particles in cosmic radiation. Also hadron-nuclei interactions and dependence on the atomic number of the target nucleus, space-time picture of collisions, coefficient of inelasticity, cross section for the interaction of particles within the nucleus, angular distribution, and multiplicity on different nuclei are considered. (JSR)

**13157** TWO-PARTICLE CORRELATIONS IN THE CENTRAL REGION OF p-p INTERACTIONS AT 200 GeV/c. Smith, G. A. (Michigan State Univ., East Lansing). pp 97-111 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

Two-particle rapidity and transverse momentum correlations are studied in the central region for a high statistics sample of events produced in pp interactions at 200 GeV/c in the Fermilab 30-inch hydrogen bubble chamber. (auth)

**13158** INCLUSIVE AND SEMIINCLUSIVE ANALYSIS IN pp INTERACTIONS AT 69 GeV/c. Blumenfeld, H. (Univ. Pierre et Marie Curie, Paris). pp 113-139 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

A more detailed analysis of multiplicity distributions for inclusive and semiinclusive pp interactions at 69 GeV/c is presented including cross sections and mass distributions is presented. (JFP)

**13159** STUDY OF THE K ANTI K S-WAVE AT THRESHOLD USING THE REACTION ANTI pp → $K^\dagger K^\dagger \pi^+\pi^-$ AT 700 TO 750 MeV/c. Bombay-CERN-Paris(College de France)-Madrid(JEN) Collaboration. pp 213-233 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

A preliminary analysis of the $K^\dagger K^\dagger$ threshold enhancement produced in the reaction $\bar{p}p \rightarrow K^\dagger K^\dagger \pi^+\pi^-$ at 700 to 750 MeV/c. A brief description is given of the experimental data, and an analysis of the $K^\dagger K^\dagger$ threshold effect (isospin, spin, and mass spectrum) is presented. Finally the connection with the $\pi\pi$ phase shifts, as determined in the $\pi p$ reactions, is discussed. (JFP)

**13160** ELASTIC AND INELASTIC PROCESSES AT THE INTERSECTING STORAGE RINGS: THE EXPERIMENTS AND THEIR IMPACT PARAMETER DESCRIPTION. Amaldi, U. (CERN, Geneva). pp 672-741 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

The experimental and impact parameter description of elastic and inelastic processes are discussed including ISR results on

proton-proton elastic scattering, total cross sections above the ISR energy range, proton-proton opaqueness and inelastic processes, and future ISR experiments. (JFP)

**13161** PHYSICS WITH MIRABELLE. Berthelot, A. (Dept. de Physique des Particules Elementaires, Saclay, France). pp 900-904 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

Experimental research using the Mirabelle bubble chamber is summarized including the study of topological cross sections, the search for correlations between charged secondary particles, inclusive photon production in p-p collisions at 69 GeV/c, and inclusive $K^0(\bar{K}^0)$ and $\Lambda^0$ production in p-p collisions at 69 GeV/c. (JFP)

**13162** SEARCH FOR NEW FAMILIES OF ELEMENTARY PARTICLES. Cline, D. B.; Mann, A. K.; Rubbia, C. Sci. Am.; 234: No. 1, 44-54(Jan 1976).

A new particle was observed at Fermilab having a mass and lifetime that place it in a region of the elementary-particle spectrum that remains almost unexplored. Its significance is that it reveals an entirely new family, the existence of which implies that there is some hitherto unobserved property of matter that distinguishes the particles in the new family from all the more familiar ones. Particle properties are reviewed in order to explain the observation of the new particle. It is suggested that a new hadron is the most likely interpretation. (JFP)

**13163** ZERO DEGREE HADRON PRODUCTION FROM AN ALUMINUM TARGET AT 300 GeV. Humphrey, T. F. Pasadena, CA; California Inst. of Tech. (1975). 227p. University Microfilms Order No. 75-24,776.

Thesis (Ph. D.).

The hadronic yields from proton-aluminum collisions into a 455 mu sr-percent beam centered at 0° were measured at a laboratory proton energy of 300 GeV and secondary momenta of 95, 120, 145 and 170 GeV/c. Using the data from this experiment one has also been able to make a study of the inclusive production of hadrons from an aluminum target. The measured neutrino and antineutrino total cross sections have an energy dependence consistent with a linear rise. In parton models (27) the sum of the slopes of these cross sections provide a measurement of the mean-square charge of the constituents of the nucleon. The measurement gives a value $[q^2]$ equals 0.27 +- 0.05 for this mean-square charge. (Diss. Abstr. Int., B)

**13164** DIFFRACTIVE COMPONENT IN PP INTERACTIONS AS SEEN IN THE NAL BUBBLE CHAMBER. Vander Velde, J. (Michigan Univ., Ann Arbor (USA); CEA Centre d'Etudes Nucleaires de Saclay, 91- Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). pp 403-410 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Experimental evidence is reviewed on the diffractive inelastic component seen in the NAL 30-inch hydrogen chamber at 102, 205, and 405 GeV/c. The integrated cross section $d\sigma/dM^2$ appears to have an s-independent low-mass peak for $M^2 < \sim 10$ GeV$^2$. The data do not support a dominant triple-Pomeron term for the cross section in the range $.90 < x < .99$. (FR)

**13165** SPIN EFFECTS IN PROTON PROTON SCATTERING. Krisch, A. D. (Michigan Univ., Ann Arbor (USA). Randall Lab. of Physics). pp 103-112 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

An experiment was done using a polarized proton beam and a polarized proton target. The cross section for elastic proton proton scattering at 6 GeV/c and $p^2 = 0.5 \rightarrow 1.6(\text{GeV/c})^2$ was measured in the spin states perpendicular to the scattering plane. The cross sections were found to be unequal by up to a factor of 2. The significance of this spin dependence is discussed along with future plans. (FR)

**13166** SMALL ANGLE PROTON SCATTERING FROM 8 TO 400 GeV. Olsen, S. L. (Rochester Univ., N. Y. (USA)). pp 219-234 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Small angle pp scattering at NAL was measured. The slope parameter b(s) and also the ratio of the real to imaginary parts of the forward scattering amplitude at energies up to 400 GeV were determined. Results are consistent with local field theory only if the pp total cross section rises through the ISR energy range. (FR)

**13167** COMPARISONS OF HIGH-ENERGY pp AND $\pi$p INTERACTIONS. Trilling, G. H. (California Univ., Berkeley (USA); European Organization for Nuclear Research, Geneva (Switzerland)). pp 423-433 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Comparisons of pp and $\pi$p interactions at 205 GeV/c incident laboratory momentum are presented. Most features of the inelastic processes are remarkably similar. (FR)

**13168** A SEARCH FOR PROMPT PRODUCTION OF ELECTRONS IN PROTON-PT COLLISIONS AT 19 GeV/c. Winter, K. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 57: No. 5, 479-482(4 Aug 1975).

Production of positrons in p-Pt collisions at 19 GeV/c has been observed in a previously reported experiment, performed to measure the mean life of the neutral pion, at $P_t = 0.54$ GeV/c, $x = 0.26$ and 37°; however, unlike similar measurements at higher energies, 30 to 1500 GeV/c, the observed effect is demonstrated to be due to $K \rightarrow \pi e \nu$ decay and $\pi^0$ Dalitz decay. After subtraction a ratio $e^+/\pi^+ = -(0.2 \pm 0.29) \times 10^{-4}$ is obtained. This first observation of energy dependence of the $e/\pi$ ratio is discussed. (auth)

**13169** MEASUREMENT OF THE POLARIZATION PARAMETER IN SMALL ANGLE PROTON-PROTON ELASTIC SCATTERING AT 6.GeV/c. Rust, D. R.; Crittenden, R. R.; Heinz, R. M.; Neal, H. A. (Indiana Univ., Bloomington (USA)); Ambats, I.; Ayres, D. S.; Diebold, R.; Jost, R. J.; Kramer, S. L.; Meyer, W. T. Phys. Lett., B; 58: No. 1, 114-116(18 Aug 1975).

The polarization parameter in pp elastic scattering was measured at 6 GeV/c with fine t resolution for $0.02 < -t < 0.5$ GeV$^2$ using a polarized beam with Effective Mass Spectrometer at the Zero Gradient Synchrotron. The polarization rises like $\sqrt{-t}$ in the interval $0.02 < -t < 0.1$ GeV$^2$. No statistical significant structure was found in this region of momentum transfer. (NL)

**13170** EXPERIMENTAL RESULTS ON LARGE ANGLE ELASTIC pp SCATTERING AT THE CERN ISR. Kwak, N.; Lohrmann, E.; Nagy, E.; Regler, M.; Schmidt-Parzefall, W.; Schubert, K. R.; Winter, K. (European Organization for Nuclear Research, Geneva (Switzerland)); Brandt, A.; Dibon, H.; Fluegge, G. Phys. Lett., B; 58: No. 2, 233-236(1 Sep 1975).

New experimental results are presented on proton-proton elastic scattering at centre-of-mass energies $\sqrt{s} = 23$ GeV and $\sqrt{s} = 62$ GeV. The data are obtained using the Split Field Magnet detector at the CERN Intersecting Storage Rings. The absolute differential cross sections show an energy-dependent behavior. The position of the diffraction minimum changes from $t = (-1.44 \pm 0.02)$ GeV$^2$ at 23 GeV to $(-1.26 \pm 0.03)$ GeV$^2$ at 62 GeV. The cross section at the second maximum is increasing with $\sqrt{s}$. The connection of these observations with the hypothesis of "geometrical scaling" is discussed. (NL)

**13171** COMMENTS ON THE $n + p \rightarrow D + 2\gamma$ ANOMALY. Bernabeu, J.; Tarrach, R. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 58: No. 1, 1-4(18 Aug 1975).

It is shown that the only theoretical contribution to the doubly radiative emission, not included in the two-step transition radiations, is given by charge bremsstrahlung from the single-photon emission. Due to the pole structure of the amplitude, the experimental energy spectrum is reproduced, but the rate is short of the measured value by more than six orders of magnitude. (NL)

**13172** CORRELATIONS OF SECONDARIES IN EVENTS WITH A FORWARD NEUTRON AT THE ISR. Amaldi, U.; Bartel, W.; Cocconi, G.; Diddens, A. N.; Dimcovski, Z.; Dobinson, R. W.; Duinker, P.; Thorndike, A. M.; Wetherell, A. M. (European Organization for Nuclear Research, Geneva (Switzerland)); Flauger, W. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). Phys. Lett., B; 58: No. 2, 213-218(1 Sep 1975).

Data, obtained from p-p collisions at centre-of-mass energies between 31 and 63 GeV, are presented on inclusive and semi-inclusive correlations between forward emitted neutrons and charged particles observed in an omnidirectional hodoscope. A

total absorption spectrometer was used to detect the neutrons and to measure their energy. Significant correlations are observed over the whole rapidity range. The data suggest that neutrons result from the decay of clusters emitted in the fragmentation region. (NL)

**13173** CORRELATIONS OF SECONDARIES IN EVENTS WITH A FORWARD NEGATIVE HADRON AT THE ISR. Amaldi, U.; Bartel, W.; Cocconi, G.; Diddens, A. N.; Dimcovski, Z.; Dobinson, R. W.; Duinker, P.; Thorndike, A. M.; Wetherell, A. M. (European Organization for Nuclear Research, Geneva (Switzerland)); Bellettini, G. Phys. Lett., B; 58: No. 2, 206-212(1 Sep 1975).

Data obtained from p-p collisions at centre-of-mass energies between 31 and 63 GeV are presented on correlations between momentum analyzed forward $\pi^-$, $K^-$ and $\bar{p}$ and charged particles observed in an omnidirectional hodoscope. The data show that significant correlations are present over the whole rapidity range for all three types of negative particles. The dependence on various kinematic variables suggests a cluster mechanism for the production of particles. In this picture, pions would be produced in clusters emitted in the fragmentation region while $K^-$ and $\bar{p}$ emanate from non-leading clusters. (NL)

**13174** LARGE $p_\perp$ LEPTON PRODUCTION AND THE $\psi(3100)$. Farrar, G. R.; Field, R. D. (California Inst. of Tech., Pasadena (USA)). Phys. Lett., B; 58: No. 2, 180-184(1 Sep 1975).

The invariant cross section $Ed\sigma/d^3p(s,x_{||},p_\perp)$ is determined for $pp \rightarrow \psi(3100) + X$ near $x_{||} = 0$ at NAL and ISR energies using the assumption that all large $p_\perp$ single leptons originate from the $\psi$. The single lepton data is adequately reproduced and by suitable extrapolation in $x_{||}$ agreement with the NAL $\psi$ production ($x_{||} \gtrsim 0.3$) is ensured. The magnitude of the resulting $\psi$ production cross section is, however, roughly a factor of 3 larger than that observed by the recent CCRS-ISR experiment. (NL)

## *Strong (Meson-induced)*

*Refer also to abstract 13560.*

**13175** (ANL/HEP/PR-75-54) HOW TO IDENTIFY RESONANCES ABOVE THE PHASE-SHIFT ANALYSES REGION. Yokosawa, A. (Argonne National Lab., Ill. (USA)). Jul 1975. Contract W-31-109-Eng-38. 17p. (CONF-750749-3). Dep. NTIS $3.50.

From symposium on new directions in hadron spectroscopy; Argonne, Illinois, USA (8 Jul 1975).

Interesting regularities were observed in the pi p backward elastic-scattering data at intermediate energies with respect to the effect of resonances. In addition, the reaction process is found to be peripheral. It is pointed out that one should be able to determine the properties of resonances above the region in which the phase-shift analyses were performed. (auth)

**13176** (BNL-20574) TOTAL CROSS SECTIONS OF $K^-p$ AND $K^-d$ FROM 411 TO 1065 MeV/c. Carroll, A. S.; Chiang, I. H.; Kycia, T. F.; Li, K. K.; Mazur, P. O.; Michael, D. N.; Mockett, P.; Rahm, D. C.; Rubinstein, R. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 6p. (CONF-750858-14). Dep. NTIS $4.50.

From meeting of the APS division of particles and fields; Seattle, Washington, USA (27 Aug 1975).

Total cross sections of $K^-p$ and $K^-d$ were measured between 411 and 1065 MeV/c with high statistical precision. In addition to the well known LAMBDA (1690), SIGMA (1765) and the SIGMA (1670), the data show indications of several possible structures in both I equals 0 and I equals 1 isotopic spin states. (auth)

**13177** (COO-3069-346) $K^-K^+$ AND $pi^-pi^+$ PRODUCTION IN $K^-p$ INTERACTIONS AT 13 GeV. Brandenburg, G. W. (Massachusetts Inst. of Tech., Cambridge (USA). Lab. for Nuclear Science). 1975. 27p. (CONF-750749-2). Dep. NTIS $5.00.

From symposium on new directions in hadron spectroscopy; Argonne, Illinois, USA (8 Jul 1975).

The description of the $K^-p$ experiment includes the production of phi and $rho^0$ mesons, $rho^0$-omega interference, and $S^*$ production. (JFP)

**13178** (JINR-1-8138) FOUR-BEAM EVENTS WITH STRANGE PARTICLE PRODUCTION IN $\pi^-$-p INTERACTIONS AT 16 GeV/c. Part 2. Identification of Neutral Strange Particles. Balya, E.; Balya, O.; Koka, K.; Berchanu, Sh.; Karnaukhov, V. M.; Kautish, V.; Makarenkova, A. D.; Mikhul, A.; Moroz, V. I.; Novikova, N. S. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1974. 16p. (In Russian). INIS.

15 refs.; 8 figs.; 1 table.

The identification of neutral strange particles formed in $\pi^-$-p interactions with a momentum of primary $\pi^-$ mesons of 16 GeV/c in a 2-meter hydrogen pulsed chamber at CERN is described. Results are presented of the identification and the comparison with data from other work. (tr-auth)

**13179** (LBL-4249) I. PION CHARGE-EXCHANGE AT FERMILAB AND II. SOME REMARKS ON HADRON PRODUCTION AT LARGE TRANSVERSE MOMENTA. Pripstein, M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Jun 1975. Contract W-7405-ENG-48. 57p. (CONF-7506106-1). Dep. NTIS $5.50.

From international summer school of particle physics; Montreal, Canada (16 Jun 1975).

The discussion of pion charge-exchange and hadron production at large transverse momenta includes the physics motivation, the experimental method, event selection criteria, results for the reaction $pi^-p$ yields n $pi^0$ (eta). (JFP)

**13180** (USIP-75-14) INVESTIGATION OF MESON RESONANCES IN THE REACTION $pp \rightarrow pp\pi^+\pi^-\pi^-$ AT 19 GeV/c. Allan, J.; Blomqvist, G. (Stockholm Univ. (Sweden). Fysiska Institutionen). Jul 1975. 26p. Dep. NTIS (US Sales Only) $4.00.

In the reaction $pp \rightarrow pp\pi^+\pi^+\pi^-\pi^-$ at 19 GeV/c, enhancements around 1100 and 1300 MeV/c in the $(\pi^+\pi^+\pi^-)$ and $(\pi^+\pi^-\pi^-)$ systems are analyzed. The peak at $A_3^-$ is mainly visible in association with the $\Delta^{++}(1236)$ resonance, a phenomenon analogous to the previous observed reaction type $pp \rightarrow \Delta\rho N$. In contrast, a weak enhancement at $A_1^+$ is not visible together with the $\Delta^0(1236)$ resonance. The peak at $A_1^+$ is predominantly seen in a subsample of single diffraction like events, whereas the peak at $A_3^-$ is only visible in the corresponding non-diffractive subsample. Further, there is an indication of the process $pp \rightarrow p\rho^0\rho^0p$, and finally, an observed enhancement around 1680 MeV/$c^2$ in the $(\pi^+\pi^+\pi^-\pi^-)$ system can be explained as a reflection of the peak at $A_3^-$. (auth)

**13181** FIRST LOOK AT THE 3.1 AND 3.7 STATES WITH DORIS. Wolf, G. (DESY, Hamburg). pp 3-42 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

In November 1974 the first experiments were put into operation at the DESY storage rings DORIS (= Doppelringspeicher). The measurements focussed on the newly discovered resonances at 3.1 and 3.7 GeV. First results from these experiments are presented. Decay angular distributions and particle widths are found. Cross sections and photon, lepton, and hadron pair production in the studied $e^+$-$e^-$ interactions are discussed. (auth)

**13182** RECENT EXPERIMENTAL RESULTS AT ADONE, FRASCATI. Monacelli, P. (Univ., Rome). pp 43-52 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

Preliminary results are given for the reactions $e^+e^- \rightarrow$ many hadrons, $e^+e^-$, $\mu^+\mu^-$, and photons at 3.1 GeV. Cross sections, widths, and asymmetry are discussed. (JFP)

**13183** STUDY OF THE ENERGY DEPENDENCE OF DIFFRACTIVE EXCITATION IN $pi^-p$ INTERACTIONS UP TO FERMILAB ENERGIES. Smith, G. A. (Michigan State Univ., East Lansing). pp 141-155 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Benjarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

Using new data from 100 GeV/c $pi^-p$ interactions in the FNAL 30-inch hydrogen bubble chamber-wide gap spark chamber hybrid system, the results of a study of the energy and charged multiplicity dependence of both the $pi^-$ and proton single diffractive excitation cross sections are presented. Data on the leading particle effect in inclusive $pi^-$ production are studied from 16 to 150 GeV/c. (auth)

**13184** SURVEY OF PARTIAL-WAVE ANALYSIS ON THREE-MESON SYSTEMS. Chung, S. U. (Brookhaven National Lab., Upton, NY). pp 477-550 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

A comprehensive survey is given of the mathematical formalism underlying the analysis and the experimental results of the analysis as applied to $3\pi$ and $K\pi\pi$ systems. The main aim is not so much to give an up-to-date account of the results as to combine the survey with an exposition of theoretical formulas in order to

make this a reasonably self-contained review. Results of PWA on ($3\pi$) data with emphasis on the current status of the A resonances and possible Regge recurrences of the W at mass 1669 MeV, results of PWA analysis on the $K\pi\pi$ systems including the Q region, K(1420) decay, and the L region are discussed as well as future prospects. (JFP)

**13185** SPIN-PARITY STRUCTURE OF THE ($K^-\pi^+$) AND ($\bar{K}^0\pi^+\pi^-$) SYSTEMS PRODUCED IN CHARGE EXCHANGE REACTIONS. pp 171-190 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Partial wave analyses have been performed for the ($K^-\pi^+$) and ($\bar{K}^0\pi^+\pi^-$) systems produced in the reactions $K^-p \to K^-\pi^+n$ and $K^-p \to \bar{K}^0\pi^+\pi^-n$, respectively. It is found that the S-wave ($K^-\pi^+$) system is consistent with a Breit–Wigner shape peaked at 1.3 GeV and 0.6 GeV wide. The low mass ($\bar{K}^0\pi^+\pi^-$) system composed mainly of $J^P = 0^-$, $1^+$ and $2^+$ states, resembles in its structure the $(K\pi\pi)^-$ system produced in diffractive reactions. This implies, in particular, that the presence of unnatural spin-parity states produced by natural parity exchanges cannot be considered as an exclusive characteristic of diffractive processes. A method of analysing the ($N\pi$) systems is described. (FR)

**13186** SUMMARY AND CONCLUSION. Vander Velde, J. (Michigan Univ., Ann Arbor (USA); CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). pp 505-522 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

An attempt is made to summarize the physics results of the first week of the IXth Rencontre de Moriond. (FR)

**13187** $\pi\pi$ PARTIAL WAVES FROM 0.6 TO 1.8 GeV. Estabrooks, P.; Martin, A. D. (Durham Univ. (UK)). Nucl. Phys., B; 95: No. 2, 322-346(1 Sep 1975).

High statistics $\pi^-p \to \pi^-\pi^+$ n data at 17.2 GeV/c are used to calculate the $\pi\pi$ partial-wave amplitudes in the energy range $0.6 < M_{\pi\pi} < 1.8$ GeV. Both energy independent and energy-dependent analyses are performed using Barrelet zero techniques. Four possible solutions are found for the partial waves, each containing the leading $\rho$,f,g resonances but with very different lower partial waves. Two solutions contain a $\rho'$ resonance in the g region, but it is not possible to establish the existence of other possible broad daughter resonances. It is shown that accurate measurements of $\pi^-p \to \pi^0\pi^0n$ should select the physical solution. (auth)

**13188** PARTIAL-WAVE ANALYSIS OF THE Q REGION IN THE REACTIONS $K^-p \to K^-\pi^+\pi^-p$ AND $K^-p \to \bar{K}^0\pi^-\pi^0p$ AT 14.3 GeV/c. Tovey, S. N.; Hansen, J. D.; Paler, K.; Shah, T. P. (Science Research Council, Chilton (UK). Rutherford Lab.); Borenstein, S.; Drevillon, B.; Chaurand, B.; Salmeron, R. A.; (Ecole Polytechnique, 75–Paris (France)); Borg, A. Nucl. Phys., B; 95: No. 1, 109-129(25 Aug 1975).

The reactions $K^-p \to K^-\pi^+\pi^-p$ and $K^-p \to \bar{K}^0\pi^-\pi^0p$ have been studied at 14.3 GeV/c using respectively 15 992 and 3723 events. Partial-wave analysis of the region $1.0 < m(K\pi\pi) < 1.7$ GeV has been made using a modified version of the method developed at the University of Illinois. The cross section has been measured as a function of mass for each spin-parity state of the $K\pi\pi$ system. Results from the two reactions are in excellent agreement and indicate an overall isospin of $\frac{1}{2}$. It is found that the Q enhancement is predominantly $1^+$ but that the partial-wave substates have very different branching ratios into $K\rho$ and $K^*\pi$, the $K^*\pi$ component of the $1^+$ state being similar to the $1^+$ state of the $3\pi$ system produced in the reaction $\pi p \to (3\pi)p$. (auth)

**13189** INTERFERENCE BETWEEN $\Delta^{++}$ AND $Q^-$ PRODUCTION IN $K^-p \to K^-\pi^-\pi^+p$ AT 4.25 GeV/c. MacNaughton, J. N.; Heinen, P. M.; Kittel, W.; Metzger, W. J.; Tiecke, H.G.J.M.; van de Walle, R. T. (Katholieke Universiteit Nijmegen (Netherlands). Fysisch Lab.); Jongejans, B.; Voorthuis, H. (Amsterdam Univ. (Netherlands). Zeeman Lab.). Nucl. Phys., B; 95: No. 2, 197-209(1 Sep 1975).

Evidence is found for overlap and interference between $\Delta^{++}$ and $Q^-$ production in $K^-p \to K^-\pi^-\pi^+p$ at 4.25 GeV/c. The strong forward asymmetry observed in the $\Delta^{++}$ decay is such that it cannot be explained by the contribution of $p\pi^+$S- and P-waves only. It finds a natural interpretation in terms of overlap between $\Delta^{++}$ and $Q^-$ production. The interference between $\Delta^{++}$ and $Q^-$ production is constructive over essentially the whole $\Delta^{++}$ region. (auth)

**13190** MEASUREMENT OF $K^-p$ ELASTIC DIFFERENTIAL CROSS SECTIONS BETWEEN 610 AND 943 MeV/c. Adams, C. J.; Davies, J. D.; Dowell, J. D.; Grayer, G. H.; Hattersley, P. M.; Homer, R. J.; Howells, R. J.; McLeod, C.; McMahon, T. J.; van der Raay, H. B. (Birmingham Univ. (UK). Dept. of Physics). Nucl. Phys., B; 96: No. 1, 54-66(15 Sep 1975).

Measurements of $K^-p$ elastic scattering have been carried out at 14 momenta between 610 MeV/c and 943 MeV/c over the angular range $-0.9 < \cos\theta < 0.9$. The results agree well with the best existing data and have significantly smaller errors. (NL)

**13191** INCLUSIVE $K^{*-}(890)$ AND $\bar{K}^{*0}(890)$ PRODUCTION IN 14.3 GeV/c $K^-p$ INTERACTIONS. Paler, K.; Tovey, S. N.; Shah, T. P.; Phelan, J. J.; Miller, R. J. (Science Research Council, Chilton (UK). Rutherford Lab.); Spiro, M.; Barloutaud, R.; Bardadin-Otwinowska, M.; Borg, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires); Chaurand, B. Nucl. Phys., B; 96: No. 1, 1-28(15 Sep 1975).

Results on the inclusive reactions $K^-p \to K^{*-}(890) + X^+$ and $K^-p \to \bar{K}^{*0}(890) + X^0$ at 14.3 GeV/c are presented. A comparison is made with previous data and with the reaction $K^-p \to \bar{K}^0 + X$ at 14.3 GeV/c. Predictions of a triple-Regge model for the variation of the unnatural and natural parity exchange with the mass of the X system are examined. The experimental values of the structure functions are compared with those calculated from a quark model. (NL)

**13192** $A_2^0$ PRODUCTION BY CHARGE EXCHANGE IN $\pi^+n$ INTERACTIONS AT 4 GeV/c. Emms, M. J.; Jones, G. T.; Kinson, J. B.; Stacey, B. J.; Votruba, M. F.; Woodworth, P. L. (Birmingham Univ. (UK)); Bell, I. G.; Dale, M.; Evans, D.; Major, J. V. Phys. Lett., B; 58: No. 1, 117-120(18 Aug 1975).

A partial wave analysis of the reaction $\pi^+n \to \pi^+\pi^-\pi^0p$ yields an $A_2^0$ production cross section of $225 \pm 30\mu b$ for momentum transfer squared $< 1(GeV/c)^2$; the differential cross section and density matrix are presented and compared with $\omega^0$ production in the light of theoretical models. (NL)

**13193** MEASUREMENT OF ELASTIC $\Sigma^-p$ SCATTERING AT 17.2 GeV/c. Blaising, J. J.; Chatelus, Y.; Morand, R.; Navard-Savoy, A. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France)); Badier, J.; Romana, A.; Vanderhaghen, R.; Videau, H.; Videau, I. (Ecole Polytechnique, 75 - Paris (France)); Callot, O. Phys. Lett., B; 58: No. 1, 121-124(18 Aug 1975).

Elastic $\Sigma^-p$ and $\pi^-p$ cross sections have been measured at 17.2 GeV/c in the t interval $-0.2, -0.38(GeV/c)^2$. The $\Sigma^-p$ slope is $b = 8.12 \pm 0.35\ (GeV/c)^2$. (NL)

**13194** $\Lambda p$ INTERACTIONS BELOW 24GeV/c. Mount, R. P.; Ansorge, R. E.; Carter, J. R.; Neale, W. W.; Rushbrooke, J. G.; Ward, D. R. (Cambridge Univ. (UK). Cavendish Lab.). Phys. Lett., B; 58: No. 2, 228-232(1 Sep 1975).

$\Lambda p$ interactions have been studied at momenta up to 24 GeV/c using a new bubble chamber technique. It is found that the $\Lambda p$ elastic cross section has fallen to approximately 6 mb at the highest momentum. Results are presented on $\Lambda p \to \Lambda p\pi^+\pi^-$ for the first time above 5 GeV/c. (NL)

## Particle Interactions and Properties (Theoretical)

**13195** HIGH ENERGY pp ELASTIC SCATTERING AND THE CHOU–YANG FORMULA. Byers, N. (Univ., Oxford). pp 742-756 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of submuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

A lecture is given in which a remarkable good fit to pp elastic scattering at $\sqrt{s} = 53$ GeV is given. It includes a summary of presently available information concerning the energy dependence of the pp elastic scattering data taken over the ISR range of energies $31 \le \sqrt{s} \le 53$ GeV, a discussion of the Chou–Yang formula, and a parton model interpretation of this formula. (JFP)

**13196** EVOLUTION OF ELEMENTARY PARTICLES AND THE COSMIC SPECTRAL SHIFT. Hsue, P. Y. Kexue Tongbao (Scientia) (Engl. Transl.); No. 10, 463-466(1974). (In Chinese).

Tang Hsiao Wei's hypothesis concerning the rest masses of elementary particles as increasing exponential functions of time is analyzed, and a new hypothesis including the use of sinusoidal functions of time is proposed to replace Tang's formula. The following points are brought to attention. Since natural evolution in-

volves both creation and annihilation processes, the sinusoidal periodical relationship seems to be more representative of the nature of the Universe. The sinusoidal function rather than the ever-increasing exponential function seems more plausible from the standpoint of mass-energy conservation law, without the need for compensatory interactions as a remedy. The new formula closely approximates Tang's relationship in the linear region and shows its validity in correlation with observational data. The new hypothetical formula would provide explanation for blue shift equally well in addition to red shift, if such a blue shift is detected. (IAA)

## General

*Refer also to abstracts 13124, 13127–13131, and 13881.*

**13197** (FERMILAB-Conf-75-78-THY) DIMUON EVENTS. Lee, B. W. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Oct 1975. 8p. (CONF-750955-2). Dep. NTIS $3.50.

From conference on gauge theories and modern field theory; Boston, Massachusetts, USA (26 Sep 1975).

An understanding of dimuon events is given based on minimal gauge theory. Included are the definition of a dimuon event, the source of such events, gross features of the minimal model interpretation, consequences and predictions, exclusive channels, and dimuon events of the same sign. (JFP)

**13198** (INIS-mf-1806) ONE-BOSON-EXCHANGE MODELS AND REGGE POLES. A Study of Low Energy Nucleon–Nucleon and Hyperon–Nucleon Scattering. Rijken, T. A. (Katholieke Universiteit Nijmegen (Netherlands)). 1975. 260p. INIS.

NN and Λp experimental data and the SU(3) classification are reviewed, and the theory of low energy NN- and YN-interactions (Y is a hyperon) is described and developed in the context of the analytic s-matrix theory using the new strip approximation. A hard-core-one-boson exchange model is described in detail and the results displayed for both the NN and YN-channels. (INIS)

**13199** (IPNO/TH-75-20) MULTIMESON-EXCHANGE IN NON-ABELIAN GAUGE THEORIES. Lukaszuk, L.; Pham, X. Y. (Institute of Nuclear Research, Warsaw (Poland); Paris-11 Univ., 91–Orsay (France). Inst. de Physique Nucleaire). May 1975. 26p. Dep. NTIS (US Sales Only) $4.50.

Asymptotic properties of two-body scattering amplitudes ($s \to \infty$, $|t| \leq$ constant) in the context of theories with Yang-Mills coupling structure are discussed. The summation of leading logarithm terms in the 2-body perturbative unitarity approximation is performed. The resulting amplitude is characterized by group structure and boson's mass only, and is independent of coupling constant. It exhibits shrinking diffractive pattern. (auth)

**13200** (JINR-P1, 2-8529) INTERNATIONAL SCHOOL-SEMINAR ON ACTUAL PROBLEMS OF ELEMENTARY PARTICLE PHYSICS, SOCHI, USSR, OCTOBER 10–19, 1974. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 585p. (In Russian). (CONF-7410136). Dep. NTIS (US Sales Only) $32.50.

This collection includes lectures and reports on the most important problems of elementary particle physics: strong interactions at high energies, multiple process phenomenology, the general principles of quantum field theory, electromagnetic interactions, etc. Abstracts were prepared for the 20 papers compiled. (auth)

*For abstracts of individual papers see: 13122, 13123, 13156, 13201–13204, 13266, 13267, 13328, 13374–13376, 13434–13436, and 13840–13843.*

**13201** (JINR-P1, 2-8529, pp 9-38) THEORIES OF R OPERATIONS. Anikin, S. A.; Zav'yalov, O. I.; Polivanov, M. K. (Lebedev Inst. of Physics, Moscow). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The theories of R operations are discussed, including the resolution of recursion relations and proof of the Bogolyubov–Parasyuk theorem. The basic determinations and symbols are first defined. The structure of R operations is analyzed in detail. (JSR)

**13202** (JINR-P1, 2-8529, pp 144-158) OPERATOR METHOD FOR THE SOLUTION OF THE QUASIPOTENTIAL EQUATION AT HIGH ENERGIES. Goloskokov, S. V.; Kuleshov, S. P.; Mitryushkin, V. K.; Smondyrev, M. A. (Joint Inst. for Nuclear Research, Dubna, USSR). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The basis of the operator method in its application to the solution of the quasipotential equation at high energies is discussed. The method is first formulated for a description of the high energy scattering of scalar particles. (JSR)

**13203** (JINR-P1, 2-8529, pp 177-237) COMPLEX SINGULARITIES AND THE REGGE COMPLEX POLE MODEL. Zotov, N. P.; Tsarev, V. A. (Moscow State Univ.). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The theoretical premises of the Regge complex pole model and its application to the description of scattering processes of elementary particles at high energies are reviewed. The theoretical justification of the model in the relativistic theory is given and the first results obtained with the model are described. Some of the later results in the application of the model to a phenomenological description of diffraction processes are examined. (JSR)

**13204** (JINR-P1, 2-8529, pp 263-281) EIKONEL DESCRIPTION OF THE RELATIVISTIC SCATTERING OF COMPOSITE PARTICLES AND VARIABLE LIGHT CONE. Kvinikhidze, A. N. (Mathematics Inst., Tbilisi, USSR); Slepchenko, L. A. 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

By the solution of the quasipotential three-dimensional equations it is shown how the longitudinal motion of components within the composite particle can be parameterized in a self-model form. The results obtained are compared for any Lorentz system of reference. (JSR)

**13205** (NBI-HE-75-5) QUANTUM DESCRIPTION OF A TWISTABLE STRING AND NEVEU–SCHWARZ–RAMOND MODEL. Krammer, A. B.; Nielsen, H. B. (Niels Bohr Institutet, Copenhagen (Denmark)). 22 Sep 1975. 33p. Dep. NTIS (US Sales Only) $4.00.

A quantum description of a twistable string is developed, and it is shown that it can be described in terms of Fermi fields having Thirring model interaction. Regularized solutions for the twisting string can then be obtained from the known solutions to the Thirring model. It is also argued that the intrepretation of the Neveu-Schwartz and Ramond models in terms of the X-Y model for an antiferromagnetic chain is just a special case of the string interpretation. In fact a twisting stick with moment of inertia density $1/\pi$, when speed of torsional sound and ħ are units, coincides in the long wavelength limit with the X-Y model and may thus be speculated to be a physical model for the dual fermion model. (auth)

**13206** (JINR-R-2-7937) ON A PARAMETRIZATION OF THE BINARY REACTION AMPLITUDES. Chavlejshvili, M. P.; Sheftel, M. B.; Rerikh, K. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. (In Russian). INIS.

13 refs.; submitted to Trudy Tbilisskogo Gosudarstvennogo Universiteta.

Possible parametrization of the amplitude of binary reactions based on introduction of new invariant variables is considered. A unique description of dispersion at small and large angles with high energies was obtained. (tr-auth)

**13207** (JINR-R-4-8220) ON CORRELATIONS AND DISTRIBUTIONS OF THE PARTICLE NUMBER WITHIN PARTIAL VOLUMES. Tsishe, P.; Zagbrebnov, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 21p. (In Russian). INIS.

9 refs.; 1 fig.

Consideration was given to how, from a function of the distribution of a multi-particle system of arbitrary statistics, the distribution and correlation of the number of particles in separate volumes could be determined. All results obtained were used for both quantum and classical statistics. (tr-auth)

**13208** (USIP-75-06) FINITE CROSSING SUM RULES FOR PARTIAL WAVE HELICITY AMPLITUDES. Johnson, D. (Stockholm Univ. (Sweden). Fysiska Institutionen). Apr 1975. 28p Dep. NTIS (US Sales Only) $4.00.

A method is given for deriving finite crossing sum rules for partial waves of helicity amplitudes of four-particle reactions with general spins and masses. The method constitutes an algorithm for constructing a complete set of sum rules and yields explicit formulas for them. (auth)

**13209** PHYSICAL INTERPRETATION OF DUAL MODELS. Rebbi, C. (CERN, Geneva). pp 62-112 of Laws of Hadronic

Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

Self-contained lectures are given on the physical interpretation of dual models defining the dynamical system by introducing a Lagrangian function and an action functional as a starting point. The physical system, the transverse gauge, the interaction and related problems, and the outlook: models of Neveu and Schwartz, and Ramond, towards new field theories. (JFP)

**13210** ABSORBED MULTIPERIPHERALISM AND RISING CROSS SECTIONS. Caneschi, L. (CERN, Geneva). pp 316-330 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

The discussion of absorbed multiperipheralism and rising cross sections includes ladders, troubles, absorbed multiperipheralism, asymptotic properties, and an approach to asymptopia. (JFP)

**13211** LARGE MOMENTUM TRANSFERS AND COMPOSITENESS. Caneschi, L. (CERN, Geneva). pp 332-354 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

The connections that are expected among the phenomena of inclusive and exclusive current experiments, exclusive hadron experiments, and inclusive production at large transverse momentum in hadron–hadron collisions are exhibited in an elementary component approach, by explicitly developing a very simple picture of the hadrons as relativistic bound states of two (or more) quarks. Form factors and two-body scattering, virtual $\gamma$ inclusive interactions, inclusive production of hadrons of large transverse momentum, and the quark production problem are covered. (JFP)

**13212** ROLE OF THEORETICAL AND EXPERIMENTAL PHYSICS IN THE UNDERSTANDING OF NATURE. Zichichi, A. (CERN, Geneva). pp 907-909 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

A discussion is given of the relative value and contributions of theoretical and experimental physics to the understanding of nature. (JFP)

**13213** SEMI-INCLUSIVE RAPIDITY DISTRIBUTIONS. Baier, R. (Univ. of Bielefeld, Ger.); Widder, F. Nuovo Cim., 30A: No. 2, 169-194(21 Nov 1975).

The expansion of semi-inclusive distributions in terms of inclusive spectra and moments of the multiplicity distribution is re-examined in a systematic way for short-range order models. The predictions of cluster models are investigated and compared with data. (auth)

**13214** EXTENDED SINGULARITIES OF THE ELECTROMAGNETIC FIELD AS MODELS OF ELEMENTARY PARTICLES. Barut, A. O. (Univ. of Colorado, Boulder). pp 103-115 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).

From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.

Because the action integral of the electromagnetic field is nonlinear in the field variables, the variational principle applied to fields which are defined in nonsimply connected domains, i.e. fields with singular regions, yields the equation of motion of fields, of singularities, and of their mutual interactions. (auth)

**13215** TWISTORS AND PARTICLES: AN OUTLINE. Penrose, R. (Mathematical Inst., Oxford). pp 129-145 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).

The treatment of twistor theory includes its description, applications for particle classification and interactions, and scattering amplitudes, and the twistor formalism. (JFP)

**13216** PHILOSOPHY OF ALTERNATIVES. von Weizsaecker, C. F. (Max-Planck-Institut, Starnberg, Ger.). pp 213-230 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).

From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.

The discussion of the philosophy of alternatives includes semantical consistency, temporal logic, probability, quantum theory, space-time continuum, the definition of a particle, the number of required urs (where a ur is the simplest possible object having a two-dimensional Hilbert space), the production of urs, and the mass spectrum. (JFP)

**13217** HIGH ENERGY INFORMATION FROM NUCLEON–ANTINUCLEON ANNIHILATION AT REST. Pelaquier, E. (Montpellier-2 Univ., 34 (France). Dept. de Physique Mathematique). pp 493-504 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Than Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The description of $\bar{N}$ N annihilation at rest in a model which involves only quasi–2 body decays gives the main features of the charged pions' experimental spectra and predicts some unknown spectra ($\pi^0$, $\rho$, $\omega$). An attempt is made to describe the projectile's fragmentation part in inclusive reactions using the $\bar{N}$ N systems as a prototype of a heavy meson. The valence part of the hadron structure function in the deep-inelastic scattering can be obtained by assuming the $\bar{N}$ N decay into pions to be a picture of some meson's fragmentation in its constituents, for instance partons. (FR)

**13218** DUAL PERIPHERAL MODEL. Schrempp, B.; Schrempp, F. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 113-134 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

An s channel approach to non-diffractive two-body reactions at high energies is reviewed. The amplitudes are described in terms of one single peripheral Regge trajectory $\alpha(s)$ in the s channel [Re $\alpha(s) + \frac{1}{2}$ approximately equal to k.R, R = hadron radius approximately equal to 1 fermi] and its analytic continuation $\alpha(u)$ to the u channel. Im $\alpha(s)$ is determined at high energies from Re $\alpha(s)$ via an (inverse) dispersion relation. The resulting non-linear, complex trajectory $\alpha(s)$ turns out to generate interesting t channel Regge (pole and cut) features involving an effective non-linear t channel trajectory $\alpha(t)$ approximately equal to $\alpha_0 - R/\pi\sqrt{-t}$ (for $-t \gtrsim 0.25$ GeV$^2$). Consequences are discussed; various tests and also new applications are presented. (FR)

**13219** ELECTROMAGNETIC PROPERTIES OF HADRONS IN A RELATIVISTIC QUARK MODEL. Boehm, M. (European Organization for Nuclear Research, Geneva (Switzerland)); Joos, H.; Krammer, M. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). pp 221-230 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Results from a relativistic dynamical quark model are presented for: the vector-meson-photon coupling constants for ordinary and heavy vector mesons; the total $e^+e^-$ annihilation into hadrons; the pion form factor in the space- and time-like region. (FR)

**13220** THERMODYNAMICAL INTERPRETATION OF THE "SCALING IN THE MEAN" IN $P_t$-DISTRIBUTIONS. Pazzi, R. (Univ., Pisa, Italy). Lett. Nuovo Cim.; 14: No. 15, 544-546 (13 Dec 1975).

It is shown that a given scaling equation, integrated over the longitudinal momentum, can be related to the prescriptions of the thermodynamical model in the pionization region. (JFP)

**13221** INTRODUCTION OF A "REFRACTIVE INDEX" ON THE DUAL STRING. Strumia, A. (Univ., Bologna). Lett. Nuovo Cim.; 14: No. 15, 547-552(13 Dec 1975).

A possible modification of the usual string theory is considered such that equivalence between the N-dimensional model and the modified string can be verified. A stringlike system governed by a given action integral is discussed. It is found that the possibility of extending the string theory to an N-dimensional model seems to be proved completely, since the elimination of ghosts from the spectrum is performed. (JFP)

**13222** EFFECT OF CLUSTERING ON THE POMERON IN A SIMPLE MULTIPERIPHERAL MODEL. Freeman, J. R.; Zarmi, Y. (Weizmann Inst. of Science, Rehovot, Israel). Lett. Nuovo Cim.; 14: No. 15, 553-558(13 Dec 1975).

A very simple multiperipheral cluster model is studied whose essential features are physically motivated. Owing to its simplicity, the model loses some of the power of detailed bootstrap schemes.

On the other hand, it has the virtues of explicitly demonstrating the qualitative interrelation between various input assumptions and output parameters. The starting point is a Chew–Pignotti-type multiperipheral model into which one introduces correlations that simulate the cluster structure of production amplitudes. (JFP)

**13223** PRELIMINARY RESULTS ON HADRON PRODUCTION IN ELECTRON POSITRON COLLISIONS AT SPEAR. Augustin, J. E.; Boyarski, A. M.; Breidenbach, M.; Bulos, F.; Dakin, J. T.; Feldman, J.; Fischer, G. E.; Fryberger, D.; Hanson, G.; Jean-Marie, B. (Stanford Linear Accelerator Center, Calif. (USA)). pp 139-160 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Preliminary results are presented on the total hadronic cross section, charged multiplicities, inclusive spectra, and an exclusive channel, a four pion final state. (FR)

**13224** DUALITY, HIGH MOMENTUM TRANSFERS, AND COMPOSITE PARTICLE MODELS. Coon, D. D. (Pittsburgh Univ., Pa. (USA). Dept. of Physics). pp 95-102 of Interactions Hadroniques a Hautes Energies. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The relation between dual models, parton models and the strength of the gluon coupling constant (g) is discussed. The connection between composite particle models of the large -t region and the resonance region is examined. Also discussed is a dual model argument of Arik and Coon in which quark production is estimated to be of the order of $\exp(-g^2/2)$ times typical hadronic cross sections. Phenomenologically, g is sufficiently large that quark production may well be unobservably small. (FR)

**13225** REGGE BEHAVIOR IN INCLUSIVE REACTIONS AND THE CONSTITUENT INTERCHANGE MODEL. Blankenbecler, R. (Stanford Linear Accelerator Center, Calif. (USA)). pp 75-94 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The constituent interchange model together with the concept of hadronic bremsstrahlung is used as a basis for describing the Reggeization of the basic interaction mechanism. Both exclusive and inclusive scattering are discussed as well as their detailed connection in analogy with Bloom-Gilman duality. The expected behavior of the inclusive cross section throughout the entire Peyrou plot is discussed. Important corrections to the triple Regge formula are evaluated and qualitatively compared to data. Finally, the expected pattern of the final states in large transverse momentum events is qualitatively described. (FR)

**13226** CLUSTER MODEL AND STRUCTURE IN THE TWO-PARTICLE RAPIDITY PLANE IN INCLUSIVE AND SEMI-INCLUSIVE CORRELATIONS. Ranft, G. (European Organization for Nuclear Research, Geneva (Switzerland); Karl-Marx-Universitaet, Leipzig (German Democratic Republic). Sektion Physik). pp 445-450 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Detailed study of the structure in the rapidity plane allows to determine the amount of single and double diffraction within a cluster model. From semi-inclusive data on correlations the average number of particles due to decay of one cluster can be estimated. (FR)

**13227** RESCATTERING CORRECTIONS AND THE POMERON STRUCTURE. Ciafaloni, M. (European Organization for Nuclear Research, Geneva (Switzerland)); Marchesini, G. (Parma Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Milan (Italy)). pp 339-351 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

An approximate treatment of long-range absorption due to elastic rescattering of pairs of particles in the final state is given. By this method absorptive corrections to Pomeron vertex and propagator is estimated and the strong coupling scheme of the Gribov calculus discussed. (FR)

**13228** MISSING PARTICLES. Adair, R. K. (Yale Univ., New Haven). pp 318-374 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of submuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The searches for missing particles are considered covering magnetic monopoles, quarks, charm and color, the intermediate vector bosons, and heavy leptons. (JFP)

**13229** NOTE ON THE DETECTABILITY OF CHARMED PARTICLES. Heusch, C. A. (Univ. of California, Santa Cruz). pp 644-649 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

A discussion is given of the possible detection of the charmed quark including the reason for charm, the detection of charmed hadrons, the charm experiment of the Santa Cruz-SLAC collaboration, and what to look for. (JFP)

**13230** ORIGIN OF EXCHANGE DEGENERACY. Kleinert, H. (Freie Univ., Berlin). pp 680-694 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of submuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

A lecture is given which will shed more light on the phenomena of exchange degeneracy in order to understand this approximate symmetry at a similar level as has been developed in the past for chiral symmetry. It is shown that there is a corresponding set of observable charges existing for the description of the approximate symmetry of exchange degeneracy as well as for chiral symmetry. (JFP)

**13231** SPONTANEOUS CP NONCONSERVATION. Lee, T. D. (Columbia Univ., New York). pp 720-733 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The idea that the vacuum state, though Lorentz-invariant, may resemble a medium and that this may explain why there is a large variety of missing symmetries is illustrated by giving a simple example in connection with CP nonconservation. (JFP)

**13232** SEPARATION OF KINEMATICS AND DYNAMICS IN THE RELATIVISTIC TREATMENT OF COMPOSITE PARTICLES. Morpurgo, G. (Univ., Genoa). pp 734-763 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The treatment of the separation of kinematics and dynamics in the relativistic treatment of composite particles covers the exemplification of the problem, a classical description of the motion of a rapidly moving bound system having a nonrelativistic internal motion, the quantization problem, wave functions and their normalization, electromagnetic interaction of a composite system, and quantum mechanical treatment. (JFP)

**13233** QUARKS IN A BAG. Weisskopf, V. F. (Massachusetts Inst. of Tech., Cambridge). pp 776-784 of Lepton and Hadron Structure. Vol. 12 Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The physical ideas underlying a previous attempt to construct a theory of hadrons in which the spatial confinement of quarks appears as a fundamental part of the theory are illustrated. The basic ideas of that theory are used to derive in a simple semi-quantitative way a number of results which seem to be more or less in accord with experimental facts. (JFP)

**13234** COMPLETE EXPERIMENTS IN PSEUDOSCALAR PHOTOPRODUCTION. Barker, I. S.; Donnachie, A.; Storrow, J. K. (Manchester Univ. (UK). Dept. of Physics). Nucl. Phys., B; 95: No. 2, 347-356(1 Sep 1975).

Necessary and sufficient conditions are derived for three double polarization measurements to complement cross section and single polarization measurements in pseudoscalar meson photoproduction to enable amplitudes to be determined up to discrete ambiguities. Rules for choosing two further measurements to resolve the discrete ambiguities are given and practical applications of the rules to particular reactions are discussed. (auth)

**13235** PHOTON PROPAGATION FUNCTION AND CHARGED VECTOR MESONS. Phares, A. J. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 94: No. 3, 501-512(18 Aug 1975).

The one-loop contribution to the photon propagation function due to the exchange of a pair of vector mesons is presented in the context of source theory. An arbitrary magnetic moment k is considered and the derived spectral form has the expected ultraviolet divergence (logarithmic when k = O, and linear when k not equal to O). This difficulty can be circumvented in the case k = O, when making use of a non-casual method based on the euclidean postulate, as stated in source theory, and Schwinger's modified propagation function for spin-1 particles. (auth)

**13236** LECTURES OF THEORY OF HADRON–NUCLEUS SCATTERING. Czyz, W. (Inst. of Nuclear Physics, Krakow). pp 139-163 of Investigation of Nuclear Structure by Scattering Processes at High Energies. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From international school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974). See CONF-7409109-.

An attempt is made to connect the reasonably well understood processes of elastic and quasielastic hadron-nucleus collisions at high energies and the poorly understood processes of particle production in hadron-nucleus interactions. The model presented relies on the assumption that the s matrix for high energy hadron-nucleus interactions is the product of the individual hadron-target nucleon s matrices. This leads to a unified picture of these interactions if unitarity at all levels is observed. It is suggested that this principle of product s matrices is valid only at very high energies when short time behaviors of hadronic processes are sufficient to describe production. (SDF)

**13237** VALIDITY OF THE SCALING LAW FOR PARTIAL-WAVE AMPLITUDES. Haan, O.; Muetter, K. H. (Heidelberg Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., B; 94: No. 3, 365-373(18 Aug 1975).

It is shown that the scaling law for partial-wave amplitudes $\mathrm{Im}\, f^l(s)$ holds for $l > (\sqrt{s}/4\mu)\,(\alpha(4\mu^2) - 1) \log s$, if the leading Regge singularity $\alpha(t)$ in the t-channel is bounded by $\mathrm{Re}\,\alpha(t) \leq \alpha(4\mu^2) + ((\alpha(4\mu^2) - 1)/2\mu)\,(\sqrt{t} - 2\mu)$ and is smooth near $t = 4\mu^2$. (auth)

**13238** SOFT DILATONS AND SCALE RENORMALIZATION IN DUAL THEORIES. Ademollo, M. (Instituto Nazionale di Fisica Nucleare, Florence (Italy)); D'Adda, A.; D'Auria, R.; Gliozzi, F.; Napolitano, E.; Sciuto, S. (Trieste Univ. (Italy). Instituto di Fisica); Di Vecchia, P. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Nucl. Phys., B; 94: No. 2, 221-259(11 Aug 1975).

The divergences arising in the dual loops are studied in some detail. They are a consequence of the existence of a massless and spinless particle of the pomeron sector, which can make an on-shell transition into the vacuum. Using the fact that this particle is a "dilaton" (i.e., it couples to the trace of the energy momentum tensor of the string) it can be proved that the sum over the divergent parts of the dual loops provides a renormalization of the Regge slope $\alpha'$ and the coupling constant g. In particular the procedure of renormalization preserves the relation between the coupling constants of the pomeron and the reggeon sector. (auth)

**13239** ROLE OF PRODUCTION MECHANISMS IN RISING CROSS SECTIONS. Bishari, M. (Weizmann Inst. of Science, Rehovoth (Israel)). Nucl. Phys., B; 95: No. 2, 231-236(1 Sep 1975).

The interplay among the various mechanisms in generating a rise in cross sections is discussed in the framework of the recently proposed S-channel absorption equation. This approach simultaneously controls the energy behavior of the diffractive and non-diffractive components. (auth)

**13240** LIGHT-CONE PHYSICS, CURRENT ALGEBRA AND PCAC. Boiti, M.; Maiella, G.; Pempinelli, F. (Lecce Univ. (Italy). Instituto di Fisica). Nucl. Phys., B; 95: No. 2, 301-321(1 Sep 1975).

It is shown that the light-cone operator expansion of the product of two SU(3) cross SU(3) currents or divergences, the requirements of maximal analyticity of the second kind, and the mathematical method of analytic continuation can be used to shed light on the validity and meaning of the Ward-Takahashi identities, of the Bjorken-Johnson-Low limit and in general of sum rules derived from current algebra either at equal time or on the light cone. In particular a definite content to the PCAC hypothesis is given in terms of the "dimension" of the axial divergences and some specific values for this "dimension" are suggested. It is also shown that the requirement of maximal analyticity of the second kind and gauge invariance impose a non-trivial condition on the Cornwall-Corrigan-Norton sum rule. (auth)

**13241** A FOKKER-PLANCK OPERATOR FOR UNLIKE-PARTICLE COLLISIONS CONSERVING PARALLEL MOMENTUM. Rolland, P.; Werkoff, F. (CEA Centre d'Etudes Nucleaires de Grenoble, 38 (France). Dept. de la Physique du Plasma et de la Fusion Controlee). Phys. Lett., A; 54: No. 1, 15-16(11 Aug 1975).

The results of Rosenbluth et al. are generalized to the case of unlike-particles. The equation obtained automatically conserves parallel momentum. (auth)

**13242** MESON HYPERFINE SPLITTINGS AND LEPTONIC DECAYS. Barbieri, R.; Koegerler, R.; Kunszt, Z. (European Organization for Nuclear Research, Geneva (Switzerland)); Gatto, R. (Rome Univ. (Italy). Instituto di Fisica). Phys. Lett., B; 57: No. 5, 455-459(4 Aug 1975).

The $^3S$-$^1S$ mass separations of the bound quark-antiquark systems, as arising from one-gluon exchange, in the charm color quartet scheme, are discussed for the ground mesons and their first radial excitations especially in connection to leptonic decay rates. Overall consistency requires large modifications for the positronium-like formulae for annihilation and the possible role in this direction of an outstanding gluon radiative correction to the leptonic width is pointed out. (auth)

**13243** RECALCULATION OF THE SINGLE PLANAR DUAL FERMION LOOP. Winnberg, J. O. (Goeteborg Univ. (Sweden). Institutionen foer Teoretisk Fysik). Nucl. Phys., B; 94: No. 2, 205-220(11 Aug 1975).

The single planar fermion loop amplitude in the Neveu-Schwarz-Ramond model is calculated. In particular, the partition function occurring in the amplitude is determined, using the method developed by Brink and Olive. The amplitude is then compared to that for the meson loop. Using the corrected relation between the coupling constants, it is found that the leading divergences do not cancel. (auth)

**13244** A DUAL RESONANCE MODEL AS A BROWNIAN PROCESS. Saito, S. (Tokyo Metropolitan Univ. (Japan). Dept. of Physics). Nucl. Phys., B; 94: No. 2, 344-364(11 Aug 1975).

A dual resonance model is formulated as a Brownian motion of strings on a flow of some material. It obeys the Mayer-Montroll equation of classical statistical mechanics which enables us to make a fugacity expansion. Certain divergences in the conventional loop expansion are absent in each term of the fugacity expansion, thus showing that the Kikkawa-Sakita-Virasoro dual amplitude is, by itself, free from these divergences, if all the diagrams are added and rearranged properly. In particular the first order term of the fugacity expansion reproduces the renormalized Neveu-Scherk one-loop amplitude, when the dimension of space-time is twelve. (auth)

**13245** IMPLICATIONS OF SCALING FOR THE PROTON-NEUTRON MASS DIFFERENCE. Gasser, J.; Leutwyler, H. (Bern Univ. (Switzerland). Inst. fuer Theoretische Physik). Nucl. Phys., B; 94: No. 2, 269-310(11 Aug 1975).

It is assumed that the structure functions $V_1$, $V_2$ scale and do not contain fixed poles at integer values of $\alpha = 0, 1, 2 \ldots\ldots$ This leads to a logarithmically divergent self-energy. A tadpole term is included in the Lagrangian. The divergent part of the self-energy is absorbed in a renormalization of the tadpole coupling constant. Using the available data low and high-energy contributions to the electromagnetic mass shift of the nucleons are then carefully evaluated. The conclusions agree with the tadpole model of Coleman and Glashow. In the quark-model language this result corresponds to the values $m_u \simeq 4$ MeV, $m_d \simeq 6$ MeV and $M_s \simeq 135$ MeV for the masses of up, down and strange quarks respectively. (auth)

**13246** CURRENT FRAGMENTATION IN DEEP INELASTIC SCATTERING. Hamer, C. J. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Nucl. Phys., B; 95: No. 1, 173-188(25 Aug 1975).

It is argued that the current fragmentation products in deep inelastic electron scattering will not be distributed in a "one-dimensional" rapidity plateau as in the parton model picture of Feynman and Bjorken. A reaction mechanism with a multiperipheral topology, by which the above configuration might have been achieved, does not in fact populate the current fragmentation plateau; and unless partons are actually observed in the final state, it cannot lead to Bjorken scaling. The basic reason for this failure is shown to be the fact that when a particle is produced in the current fragmentation plateau, the adjacent momentum transfer in the multiperipheral chain becomes large and negative: such processes are inevitably suppressed. Instead,

the current fragmentation products are likely to be generated by a fragmentation, or sequential decay process. (auth)

**13247** COVARIANT EQUATIONS OF MOTION WITH EXPLICIT RADIATION DAMPING. III. The Lorentz-Dirac Equation and its Generalization to a Magnetic Dipole Particle. van Weert, C. G. (Amsterdam Univ. (Netherlands). Instituut voor Theoretische Fysica). Physica; 80: No. 3, 247-259(1975).

The general formalism developed in the first two papers of this series is applied to the case of a charged particle and a charged dipole particle having a magnetic moment. A new method for the calculation of the radiation-reaction terms is presented. (NL)

**13248** COVARIANT EQUATIONS OF MOTION WITH EXPLICIT RADIATION DAMPING. II. Comparison with the Theory of Bhabha and Harish-Chandra. van Weert, C. G. (Amsterdam Univ. (Netherlands). Instituut voor Theoretische Fysica). Physica; 80: No. 3, 234-246(1975).

A relation is established between the reaction due to the radiation of a multipole particle and the reaction arising from the minus field i.e., half the difference of the retarded and advanced self fields. This leads to a new representation of the reaction terms. (NL)

**13249** BAG MODEL OF HADRONS WITH MASSIVE QUARKS. Barnes, T. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 96: No. 2, 353-364(22 Sep 1975).

The bag model of hadrons is generalized to include massive quarks and investigate in particular the properties of the $1 = 0$ octet and decimet baryons with $m_p = m_n = 0$, $m_\lambda = 270$ MeV (obtained by fitting the decimet). The magnetic moments and weak axial $\approx$ transition moments are calculated and compared with experimental data for cases in which data exists. The mechanism by which the remaining degeneracies in the baryons are lifted and modifications which are necessary to construct a bag model of mesons are also considered. (NL)

**13250** DERIVATIVE RELATIONS FOR HELICITY AMPLITUDES. Schrempp, B.; Schrempp, F. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 96: No. 2, 307-330(22 Sep 1975).

The derivative relations $F_{\Delta\lambda=1} = C_0(\delta\delta\sqrt{-t})F_{\Delta\lambda=0}$, $F_{\Delta\lambda=2} = C_1\sqrt{-t}(\delta\delta\sqrt{-t})(F_{\Delta\lambda=1}\sqrt{-t})$, for their physical motivation, their domain of validity and their power for amplitude analyses are discussed. Methods for model independent tests of these relations are presented and applied to various non-diffractive reactions ($\pi^-p \to \pi^0n$, $\gamma p \to \pi^0 p$, $\overline{K}N$ CEX) and also to $\pi N$ diffraction scattering. In all these cases the derivative relations were found to be very well fulfilled. (NL)

**13251** DUALITY AND SYMMETRY TESTS FOR MULTIPARTICLE PRODUCTION MODELS. Schmid, C.; Sorensen, C. (Eidgenoessische Technische Hochschule, Zurich (Switzerland)). Nucl. Phys., B; 96: No. 2, 209-236(22 Sep 1975).

Two-body absorptive parts generated by unitarity from multi-Regge particle production models are tested with respect to duality and symmetry structure (suppression of exotics and exchange degeneracy in output). A multi-Regge model with production of only stable particles generates exotic and non-exotic outputs of equal strength; resonances (clusters) are needed to pass these symmetry tests. Two complementary approaches are used, explicit S-matrix models and duality diagrams; the connection between dynamical assumptions and different duality diagram rules is discussed. C-parity plays a crucial role; using C-conserving duality diagrams it is shown that standard manipulations lead to a topological pomeron which has secondary terms; one, with $C_t = -1$, cancels the topological $\omega_1$ meson, another one, with $C_t = +1$, cancels the topological $f_1$ meson. (NL)

**13252** ASYMPTOTIC FREEDOM AND THE CALLAN-CROSS RELATION. Nanopoulos, D. V.; Ross, G. G. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 58: No. 1, 105-110(18 Aug 1975).

The validity of free quark model sum rules in an asymptotically free gauge theory of the strong interactions is discussed. The predictions of the Callan-Cross relation are studied in detail and comparison is made with experiment. It is concluded that data on $\sigma_L\sigma_T$ at higher energies should provide a strong test of asymptotic freedom. (NL)

**13253** QUARK ATOMS, MOLECULES AND CRYSTALS. Lipkin, H. J. (Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Nuclear Physics). Phys. Lett., B; 58: No. 1, 97-99 (18 Aug 1975).

The existence of exotic states in the nonrelativistic quark model with three triplets and an octet of coloured gluons is shown to depend on the radial dependence of the potential. Quasi-atomic potentials with smooth monotonic radial dependence do not produce exotics. Quasi-molecular potentials with repulsive cores can produce not only exotics but also bound crystal lattices. A colour dependent repulsive core becomes attractive in some states and could produce a new spectrum of "collapsed" states. (NL)

**13254** SYSTEMATIC LIFTING OF EXCHANGE-DEGENERACY THAT CLARIFIES THE RELATIONSHIP BETWEEN POMERON, REGGEONS AND $SU_3$-SYMMETRY VIOLATION. Rosenzweig, C.; Chew, G. F. (California Univ., Berkeley (USA). Dept. of Physics). Phys. Lett., B; 58: No. 1, 93-96(18 Aug 1975).

The cylinder correction to the planar S matrix splits $I = 0$ from $I = 1$, lifts exchange degeneracy of $I = 0$ states and induces deviations from ideal mixing. All three effects are approximately described by one parameter which gives the shift of the $\omega$ intercept below the $\rho$, the couplings of f, f' $\omega$, $\varphi$, the shift of the f above the $\rho$, and its tendency to become an $SU_3$ singlet heretofore labeled at $t = 0$ as the pomeron. (NL)

**13255** BOUNDS FOR THE SUM OF LADDER GRAPHS AND THE OCCURRENCE OF GHOSTS. Wanders, G. (Lausanne Univ. (Switzerland)). Phys. Lett., B; 58: No. 2, 191-193(1 Sep 1975).

Rigorous upper and lower bounds for the sum of scalar ladder graphs are derived. These bounds are compatible with Regge behaviour but reveal the existence of ghosts for sufficiently large coupling constants. (NL)

**13256** NO-GHOST THEOREM FOR THE POMERON SECTOR OF NEUVEU-SCHWARZ DUAL RESONANCE MODEL. Kaul, R. K. (Delhi Univ. (India). Dept. of Physics and Astrophysics). Phys. Lett., B; 58: No. 2, 185-190(1 Sep 1975).

With certain forms for the pomeron propagator in the non-planar single loops for the N-S model with positive G-parity, no-ghost theorem for the pomeron sector is proved by the method of Olive and Scherk. (NL)

**13257** BARYON RESONANCE COMPONENTS IN THE DEUTERON. Rost, E. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). Nucl. Phys., A; 249: No. 3, 510-522(22 Sep 1975).

A non-relativistic coupled channel calculation of the structure of the deuteron is presented with NN* configurations in addition to the usual (NN)S- and D-state components. The additional baryon resonance degrees of freedom are included by means of a one-pion exchange potential model; the nucleon-nucleon interactions are treated with conventional phenomenological potentials which contain a hard core. This core obviates the necessity for additional cutoff parameters for the singular NN* potentials. All possible NN* states of the ten currently "well established" N* resonances have been calculated using a renormalized Reid hard core potential and several NN* amplitudes are found in the 0.1 - 0.3% range. Some of these components are rather large at high momenta and thus may be observable in high momentum transfer processes. (NL)

**13258** HIGH ENERGY PHYSICS INDEX. Volume 13, No. 24, 1975. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1975). 122p.

**13259** EXCHANGE MECHANISMS IN TWO-BODY REACTIONS. Martin, A. D. (Univ. of Durham, Eng.). pp 551-580 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

A review is given of the experimental status of the symmetry relations for exchanges, SU(3)-related vector meson production reactions, line-reversed K* production reactions, exchange mechanisms from recent data, and exchange mechanisms as a function of the mass of an external particle. (JGP)

## *Electromagnetic*

*Refer also to abstracts 13135 and 13905.*

**13260** (CEA-N-1791, pp 137-138) STUDY OF THE $\gamma + D \to p + p + \pi^-$ REACTION. Argan, P.; Audit, G.; Bechade, J.; de Botton, N.; Bloch, A.; Faure, J. L.; Laget, J. M.; Martin, J.; Schuhl, C.; Tamas, G. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The $\gamma + D \to p + p + \pi^-$ reaction was studied for low values of the momentum of the spectator nucleon p(s) < 150 MeV/c). The values of the cross section of the elementary reaction $\gamma + n \to p + p + \pi^-$ extracted and agree fairly well with the value measured in other laboratories. (FR)

**13261** (CEA-N-1791, pp 151) ELECTROPRODUCTION OF THE $\pi^+$ WITH THE PROTON. Bardin, G.; Duclos, J.; Magnon, A.; Michel, B.; Montret, J. C. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The longitudinal and transverse components of the cross section for the electroproduction of a $\pi^+$ from hydrogen were obtained for a $\pi$N invariant mass of 1175 MeV and at $q^2 = a\ fm^{-2}$ ($L = 10.7(1.8)\mu b$ and $T = 5.5(1.6)\mu b$). (FR)

**13262** (COO-1545-174) PHENOMENOLOGICAL BOUNDS IN INCLUSIVE NEUTRINO INTERACTIONS. Aubrecht, G. J. II; Takasugi, E.; Tanaka, K. (Ohio State Univ., Columbus (USA). Dept. of Physics). 1975. Contract AT(11-1)-1545. 12p. Dep. NTIS $3.50.

Using expressions for the nu and anti nu charged and neutral current cross sections and the electroproduction structure function integral, and positivity requirements of the sea contribution, bounds are obtained on sigma/sup anti nu N//sigma/sup nu N, and sigma/sub nc//sup anti nu N//sigma/sub nc//sup nu N/ in the standard model. A bound on sigma/sup anti nu N//sigma/sup nu N/ obtained with a V + A term anti p'gamma/sub mu/(1-gamma$_5$)n is used to rule out such a term in the current. A plot of sigma/sub nc//sup nu N/ + sigma/sub nc//sup anti nu N/ versus sigma/sub nc//sup nu N/ – sigma/sub nc//sup anti nu N/ is introduced to analyze the neutral current data. A new relation connecting moments of y and y distributions at a particular point y/sub n/ for nu and anti nu interactions is found. The results do not depend on the neutral current data. (auth)

**13263** (IFVE-STF-74-98) ON THE POSSIBILITY OF THE NEUTRINO ELECTROMAGNETIC RADIUS TO BE LARGE. Arbuzov, B. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1974. 7p. INIS. 13 refs.

It is suggested that data on nonmuon neutrino reactions can be explained by a large electromagnetic radius of the neutrino. It is shown that a zero-order radius is obtained if one assumes that the polarization interval of the vacuum in quantum electrodynamics is similar because of the presence of additional members having properties related to $a^{\lambda}$. Basic experimental predictions of the model are described. (tr-auth)

**13264** (INIS-mf-1742) THE DEFLEXION OF PLANE ELECTROMAGNETIC WAVES IN PRESENCE OF A CENTRAL GRAVITATIONAL FIELD. Lifshitz S, I. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). 1974. 90p. (In Spanish). INIS.

The deflection of light passing the sun is calculated from the viewpoint of the Viniegra field theory. This theory, in contrast to Einstein's general relativity theory, places physics in plane Minkowski space giving physical reality to the electromagnetic and gravitational fields in place of the geometry in a Riemann space. In this theory the gravitational field of the sun behaves as a material medium in the presence of the passage of electromagnetic waves and it is possible to associate with it, at least formally, a refraction index. With this the trajectory of the light ray is obtained using known results from geometric optics. The angle between the asymptotes of each trajectory is calculated by taking the research value for the deflection. The result obtained is an attractive deflection of 0.87 in comparison with the value of 1.75 predicted by the Einstein theory. The experimental results oscillate around the value 1.75 but with a margin of error up to 70% because of the experimental difficulties. In the theoretical results predicted by the two theories effects such as the deflection caused by the solar corona, the inhomogeneous mass distribution of the sun, etc. are not taken into consideration. Therefore, it is conceivable that the theoretical result of 0.87 is in better agreement with experimental values than 1.75. (tr-INIS)

**13265** (JINR-1-7899) SEARCHES FOR SHORT-LIVED KAON DECAYS INTO TWO MUONS. Birulev, V. K.; Vestergombi, D.; Vovenko, A. S.; Genchev, V.; Grigalashvili, T. S.; Gus'kov, B. N.; Deak, F.; Kekelidze, V.; Krivokhizhin, V. G.; Kukhtin, V. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1974. 18p. (In Russian). INIS.

20 refs.; 6 figs.; 2 tables.

Using a nonfilm spark spectrometer on a beam of neutral particles of the Serpukhov accelerator, short-time studies were made on a search for decay of short-lived neutral kaons to two muons. The upper limit of the ratio of the decay width of neutral short-lived kaons to two muons to the total decay width was found to be $1.6 \times 10^{-4}$. (tr-auth)

**13266** (JINR-P1, 2-8529, pp 282-294) DISPERSION METHOD IN PROBLEMS OF SCATTERING ON BOUND STATES. Kirillov, A. I. (Mathematics Inst., Moscow); Troitskii, V. E. 1975. (In Russian)

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

A dispersion method is described which makes it possible to give a relativistic description of the scattering of electrons on bound states. The method is applied to the scattering of electrons on elementary particles, more precisely, on nucleons. (JSR)

**13267** (JINR-P1, 2-8529, pp 504-543) THEORY OF SYNCHROTRON RADIATION. Sokolov, A. A. (Moscow State Univ.). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The development of the current theories of synchrotron radiation is summarized by discussions of the derivation of formulas for the intensity of a charge moving in a spiral trajectory in the classical theory, quantum theory of the movement of electrons in a nonhomogeneous magnetic field, effect of self-polarization and the quantum theory of spin resonances, and one-photon processes in magnetic fields. (33 references) (JSR)

**13268** (NBI-HE-75-4) RADIATIVE ASYMMETRY AROUND THE RESONANCE IN $e^+e^- \rightarrow \mu^+\mu^-$. Krammer, A. B.; Lautrup, B. (Niels Bohr Institutet, Copenhagen (Denmark)). May 1975. 34p. Dep. NTIS (US Sales Only) $4.00.

Under the assumption that the $\psi$ is a pure $1^{2-}$ vector particle the angular asymmetry was calculated in the process $e^+e^- \rightarrow \mu^+\mu^-$ around the resonance. It is found that the asymmetry, calculated in the soft photon limit, becomes very small around the resonance. (auth)

**13269** (RL-75-073, pp A.1-A.8) FLUCTUATIONS OF CHARGE CONNECTED WITH THE FORMATION OF MATTER FROM RADIATION. Heisenberg, W. May 1975. Translated from Sachs. Akad. Wiss.; 86: 317-322(1934).

In quantum electrodynamics.

It is found that in the measurements of charge in a given region of space and time, fluctuations occur which have no analog in the classical theory and are caused by the matter which is formed at the surface of the region of space considered during measurement. (JFP)

**13270** (RL-75-073, pp B.1-B.10) THEORY OF THE POSITRON. Dirac, P. A. M. May 1975. Translated from pp 203-212 of Report to 7th Solvay Physics Conference, Structure and Properties of Atomic Nuclei (1934).

In quantum electrodynamics.

Using the Pauli exclusion principle by virtue of which a given quantum state can be occupied by not more than one electron, a hypothesis is described dealing with the main difficulties of the interpretation of the negative energy states. In this way the positron properties are discussed. (JFP)

**13271** (RL-75-073, pp C.1-C.27) COMMENTS ON THE DIRAC THEORY OF THE POSITRON. Heisenberg, W. May 1975. Translated from Z. Phys.; 90: 209-231(1934).

In quantum electrodynamics.

An attempt is made to embody the Dirac theory of the positron in the formalism of quantum electrodynamics. The requirement is met that the symmetry of nature in positive and negative charge find expression from the outset in the basic equations of the theory; furthermore, that except for the divergences caused by the known difficulties of quantum electrodynamics, no new infinities appear in the formalism. The study emphasizes the significance of the conservation principles for the whole radiation – matter system, and the need to formulate the basic equations of the theory in a manner which goes beyond the Hartree approximation method. (JFP)

**13272** HIGH INTENSITY COMPTON SCATTERING OFF PARTICLES WITH ANOMALOUS MAGNETIC MOMENT. Becker, W.; Koch, V.; Mitter, H. (Tuebingen Univ., Ger.). J. Phys., A (London); 8: No. 9, 1480-1488(Sep 1975).

For a particle with an anomalous magnetic moment the differential cross section for the emission of a photon due to interaction with an intense external wave field of circular polarization is calculated. The scattered frequencies appear in triplets of very small separation and there is in addition a "zeroth" harmonic of very low frequency. In the cross section the contributions from the anomalous moment add to the relativistic terms in the corresponding formula for normal particles. The transition probabilities for all three numbers of the triplets differ from each other. For neutrons only the zeroth, first and second harmonics can appear. The intensity of the zeroth harmonic turns out to be very low both for electrons and nucleons. (auth)

**13273** EXPERIMENTS INVOLVING MIRROR TRANSPONDERS IN ROTATING FRAMES. Davies, P. A.; Jennison, R. C. (Kent Univ., Canterbury, Eng.). J. Phys., A (London); 8: No. 9, 1390-1397(Sep 1975).

Two experiments are described in which mirrors were mounted on rotating turntables and measurements were made of the frequency of the reflected radiation. The order of accuracy was one part in $10^{17}$, which exceeded that required to detect second-order relativistic phenomena. It is shown that the mirrors are equivalent to transponder systems and that the application of logical arguments to the telemetered observations confirms earlier theoretical predictions of the radius and angular velocity of a rotating system measured entirely from a point within that system. (auth)

**13274** MONOPOLES-GRAVITY: A SYMMETRY APPROACH. Trinkala, M. J. Albany; State Univ. of New York (1975). 169p. University Microfilms Order No. 75-25,786.

Thesis (Ph. D.).

The symmetry structures of Einstein's theory of gravitation and Dirac's theory of electrodynamics are the major concerns. First, the gauge theoretic approach to the theory of gravitation is investigated. Secondly, the dual and chiral symmetries of electrodynamics are studied for the case when both electric charges and magnetic monopoles are present. Thirdly, the Kaluza-Klein-Hoffmann formalism is adopted so that the combined effects of electromagnetism and gravitation on an electrically and magnetically charged object may be analyzed. Finally, a brief discussion is given on the possible application of the results obtained above to the models of elementary particles. (Diss. Abstr. Int., B)

**13275** HADRONIC FINAL STATES IN PHOTO- AND ELECTROPRODUCTION. Soeding, P. (DESY, Hamburg). pp 61-90 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

A summary is given on recent results on hadronic final states in photo- and electroproduction, emphasizing traits that show differences from purely hadronic interactions and thus may point to properties characteristic of the current-induced scale invariant process. Real and virtual photons are considered. (JFP)

**13276** HADRONLIKE BEHAVIOR OF THE PROTON. Sakurai, J. J. (Univ. of California, Los Angeles). pp 252-289 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

A lecture is given examining to what extent the features of strong interaction phenomena are also shared by photoproduction and electroproduction. Included are total photoproduction cross section and vector meson photoproduction, single pion photoproduction, inclusive photoproduction, exclusive and inclusive electroproduction, the relevance of $\omega$ with respect to $q^2$, and shadowing. (JFP)

**13277** NEW DUALITY IN ELECTROMAGNETIC INTERACTIONS. Sakurai, J. J. (Univ. of California, Los Angeles). pp 290-315 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

A lecture is given presenting a new approach to the electromagnetic interactions of hadrons based on duality with respect to the $q^2$ variable. It is an attempt to unify the description based on scaling (or other asymptotic) behavior and the description based on a generalized form of vector-meson dominance. Electron—positron annihilation into hadrons, inelastic electron—proton scattering, and lepton-pair production are discussed. (JFP)

**13278** ELECTROMAGNETIC INTERACTIONS. Ting, S. C. C. (DESY, Hamburg). pp 758-810 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

Lectures are given on electromagnetic interactions including the interaction between photons, and electrons, or muons, quantum electrodynamics, the interactions between real photons and vector mesons, vector dominance, the interaction between virtual photons and hadrons, and scaling and structure functions. (JFP)

**13279** ALGEBRAIC THEORY OF COULOMB SCATTERING. Grosse, H.; Gruemm, H. R.; Narnhofer, H.; Thirring, W. (Univ., Vienna). Acta Phys. Austriaca; 40: No. 2, 97-103(1974).

The derivation of the S matrix and its convergence properties are discussed. The phase shift for Coulomb scattering and structure of the scattering automorphism are considered. (JFP)

**13280** T-CHANNEL SELECTION RULES FOR PION ELECTROPRODUCTION. Kramer, G. (Univ., Hamburg). Acta Phys. Austriaca; 40: No. 2, 150-157(1974). (In German)

The relation between the polarization of the virtual photon in the electroproduction of single pions on nucleons and the normality ($P(-)^J$) of the exchange contribution in the t-channel for high energies. The relevance of this relation for the reaction $\gamma p \to \pi^0 p$ is pointed out, and it is shown that it is valid for $E_\gamma$ = 3 GeV in a Regge pole model with absorptive cuts. (auth)

**13281** PION ELECTROMAGNETIC FORM FACTOR IN THE TIMELIKE RANGE (1.44 TO 9.0) $(GeV)^2$. Bollini, D.; Giusti, P.; Massam, T.; Monari, L.; Palmonari, F.; Valenti, G.; Zichichi, A. (CERN, Geneva). Lett. Nuovo Cim.; 14: No. 11, 418-420 (15 Nov 1975).

The results of a study of collinear charged hadron pairs produced in the reaction $e^+e^- \to h^+h^-$ reactions, where $h^\pm$ can be either a $\pi^\pm$ or a $K^\pm$, at 0.925 to 1.4 GeV are given. All data are analyzed in terms of the modulus of the $\pi$ electromagnetic form factor in the timelike range. (JFP)

**13282** REGGE EXPANSION OF A CAUSAL SPECTRAL FUNCTION OF ELECTROPRODUCTION. Ahmed, M. A.; Taha, M. O. (Univ. of Khartoum, Sudan). Nuovo Cim.; 30A: No. 2, 212-220 (21 Nov 1975).

The conjecture that a term in the Regge expansion of the Deser-Gilbert-Sudarshan spectral function in electroproduction may identically vanish is investigated. It is shown that this conjecture does not appear to be in agreement with experiment. (auth)

**13283** TENSOR AMPLITUDES FOR ELASTIC PHOTON-PHOTON SCATTERING. Leo, R. A. (Univ., Lecce, Italy); Soliani, G.; Minguzzi, A. Nuovo Cim.; 30A: No. 2, 270-286 (21 Nov 1975).

It was shown that expansions for the fourth-rank vacuum polarization tensor for a virtual four-photon system can be built up in general, in terms of seventeen linearly independent explicitly gauge-invariant polynomial tensors. A special choice of the tensor basis corresponds to the one obtained by Karplus and Neuman. One has also dealt with the real four-photon system. An expression for the tensor amplitude which describes this process was found in general, in terms of five linearly independent manifestly gauge-invariant polynomial tensors. Both in the case of massive and real photons, one has investigated the kinematical singularities of the scalar amplitudes relative to the chosen tensor bases. For the real case one has also obtained the low energy limits of the helicity amplitudes in the center-of-mass system. Finally, one has looked for the effective Lagrangian densities related to the helicity amplitudes in the low energy region. (auth)

**13284** CURRENT ALGEBRA AND THE $\eta_{3\pi}$ DECAY. McNamee, P. C. (Univ. of Catolica, Rio de Janeiro); Scadron, M. D. Nuovo Cim.; 30A: No. 2, 287-319(21 Nov 1975).

The general current-algebra-pion-PCAC constraints on the $\eta \to 3\pi$ decay amplitude are formulated independently of any model of the semi-strong and electromagnetic Hamiltonian. A wide range of models for the Hamiltonian are reviewed, and it is found that the electromagnetic "tadpole" necessary to account for electromagnetic mass splittings of hadrons is also necessary to account for the $\eta \to 3\pi$ decay. With the presence of this "tadpole" there is no PCAC problem: the background amplitude is smooth in the pion momenta. In the particular model of (3,$\bar{3}$) breaking, the $\eta \to 3\pi$ decay rates are found to be not incompatible with experiment. (auth)

**13285** INCLUSIVE PHOTOPRODUCTION AND THE TRIPLE REGGE FORMULA. Gandsman, J. (Ecole Normale Superieure, 91- Orsay (France). Lab. de l'Accelerateur Lineaire). pp 231-246 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The inclusive reactions $\gamma p \to \pi^+$ or $\pi^-$ anything and $\gamma n \to \pi^+$ or $\pi^-$ anything at the photon energy of 7.5 GeV were studied. The high $\pi^+/\pi^-$ ratio observed in the target fragmentation region is explained by applying the triple Regge formalism. The inclusive photoproduction of the $\Delta^{++}$ and $\rho^0$ resonances is also investigated. (FR)

**13286** EQUATIONS OF MOTION FOR PARTICLES WITH ARBITRARY SPIN IN NONRELATIVISTIC MECHANICS. Fushchich, V. I.; Nikitin, A. G.; Salogub, V. A. (Inst. of Mathematics, Kiev). Lett. Nuovo Cim.; 14: No. 13, 483-488(29 Nov 1975).

It is shown that within the framework of nonrelativistic quantum mechanics, when one uses an equation in a given form, the successive description of the particle with spin $s < 3/2$ motion in the external electromagnetic fields is obtained which includes the dipole, quadrupole, and the spin–orbit couplings of the particle with the field. (JFP)

**13287** GREEN'S FUNCTION OF THE FREE ELECTRON IN A UNIFORM MAGNETIC FIELD. Bellandi Filho, J.; Zimerman, A. H. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Lett. Nuovo Cim.; 14: No. 14, 520-522 (6 Dec 1975).

The stationary Green function is written which corresponds to a given value of $L_z$, the z-component of the angular momentum. As a by-product one obtains the stationary Green function of previous work. Also one can use this Green function to write the integral equation for the wave function of a hydrogen atom in a uniform magnetic field. (JFP)

**13288** GAUGE THEORIES AND DEEP INELASTIC PHENOMENA. Gourdin, M. (Univ., Paris). pp 134-204 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

Gauge theories and deep inelastic phenomena with neutral currents is discussed including the present and future, electroproduction and weak charged currents, leptonic neutral currents with neutrinos, hadronic neutral currents with neutrinos, leptonic and hadronic neutral currents without neutrinos, and charm and color. (JFP)

**13289** IS THEORETICAL PHYSICS ABLE TO EXPLAIN $e^+e^-$ ANNIHILATION INTO HADRONS. Llewellyn-Smith, C. H. (CERN, Geneva). pp 206-261 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

A review is given of the possible theoretical physics explanation of $e^+e^-$ annihilation into hadrons including the original arguments that $R \to$ constant, connection with short distances, predictions of the light-cone algebra, the Crewther relation, the parton model, the renormalization group approach, the Ferro Fontan–Rubinstein model, statistical and thermo-hydrodynamical models, the no proton mechanism, and phenomenology. (JFP)

**13290** DEEP INELASTIC PROCESSES FROM A NONORTHODOX POINT OF VIEW. Greco, M. (CNEN, Frascati, Italy). pp 262-304 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

Lectures are given on deep inelastic processes from a viewpoint unconventional in the sense that no elementary constituents are invoked but rather scaling properties are accomodated in a fairly natural way by imposing on the current-induced processes the regularities observed in purely hadronic reactions. The starting point is the attempt to unify the electromagnetic properties of hadrons both in the small $q^2 (q^2 \simeq 0)$ region, where the photon shows an hadron-like behavior with strong similarities to ordinary strong processes, and large $q^2 (q^2$ both positive and negative) deep inelastic region, where point-like behavior seems to be suggested. The central idea is that the photon is coupled to a Veneziano-like spectrum of vector states whose properties can be deduced by linking consistently various processes corresponding to different $q^2$ regions. The $e^+e^-$ annihilation into hadrons, photo- and electroproduction, deep inelastic neutrino–nucleon scattering, and inclusive deep inelastic processes are considered. (JFP)

**13291** COMPOSITE GAUGE FIELDS AND $e^+e^- \to$ HADRONS. Budini, P. (International Centre for Theoretical Physics, Trieste, Italy). pp 634-642 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

Starting from the current–current weak lepton Lagrangian one considers the attractive forces between leptons–anti-leptons originated by the exchange of neutrino pairs. A Bethe–Salpeter equation is used to study under which conditions the neutrino forces could give rise to lepton–anti-lepton massless bound states and the possible properties of these states and of their coupling to the free leptons. Then one studies the transformation properties of the composite field when the constituted spinors are gauge transformed, using an effective Lagrangian and the corresponding field equation. The proposed scheme implies a direct coupling of leptons with hadrons (JFP)

**13292** FLUX QUANTIZATION AND PARTICLE PHYSICS. Jehle, H. (Univ. of Maryland, College Park). pp 672-679 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The implications of the concept of quantized magnetic flux for the electromagnetic field and the topology of flux loops and the quark model are considered. (JFP)

**13293** ELECTRON–POSITRON COLLIDING BEAM EXPERIMENTS AT 4 GeV AND 5 GeV CENTER-OF-MASS ENERGY. Wilson, R. (Harvard Univ., Cambridge, MA). pp 786-805 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

An unequivocal demonstration is given of the idea that the ratio of the cross section for $e^+e^- \to$ hadrons exceeds the cross section for $e^+e^- \to$ muons by more than a factor of three in this energy range and that it is inconsistent with the naive quark model even with a charmed quark. (JFP)

**13294** POSSIBLE ROLE OF TWO PHOTON PROCESSES IN HIGH ENERGY COLLIDING BEAM EXPERIMENTS. Greco, M. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). pp 217-220 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

A critical analysis is presented of the theoretical expectations for the process $\gamma\gamma \to$ hadrons and its implications for high energy $e^+e^-$ annihilation into hadrons. (FR)

**13295** WHY POLARIZED ELECTROPRODUCTION IS INTERESTING. Close, F. E. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 285-306 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The data on inelastic electroproduction both in the resonance and deep inelastic regions are reviewed, the similarities between them noted and the consequences for parton models and Bloom-Gilman and Rittenberg-Rubinstein duality discussed. A preview of polarized electroproduction is made. Theoretical predictions suggest that the polarization asymmetry in the deep inelastic will have opposite sign to that in photoproduction and hence some interesting $Q^2$ dependent effects are expected. However, the available data in the resonance region do not show evidence for such a dependence and so it seems possible that either Rittenberg-Rubinstein duality will be in difficulty or that theoretical expectations based on quark partons and light cone algebra for the deep inelastic asymmetry are incorrect. (FR)

**13296** DUAL QUARKS AND PARTON QUARKS. Kitakado, S. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)). pp 307-328 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The constraints of duality are imposed on the structure functions of total as well as one-particle inclusive deep inelastic electron-nucleon scattering. (FR)

**13297** STATUS OF THE SEARCH FOR MUONLESS EVENTS IN THE BROAD BAND NEUTRINO BEAM AT NAL. Aubert, B.; Benvenuti, A.; Cline, D.; Ford, W. T.; Imlay, R.; Ling, T. Y.; Mann, A. K.; Messing, F.; Piccioni, R.; Pilcher, J. (Harvard Univ., Boston, Mass. (USA); Pennsylvania Univ., Philadelphia (USA); Wisconsin Univ., Madison (USA); National Accelerator Lab., Batavia, Ill. (USA)). pp 125-138 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The current status and results of the search for muonless events in the broad band neutrino beam at NAL are presented. An excess of events unaccompanied by muon is observed which cannot be explained by instrumental effects. The ratio of the unaccompanied events to the customary charged current events is $0.20 \pm 0.05$ for the mixture of $\nu$ and $\bar{\nu}$ in this beam. (FR)

**13298** VECTOR MESONS AND $e^+e^-$ ANNIHILATION. Renard, F. M. (Montpellier-2 Univ., 34 (France). Dept. de Physique Mathematique). pp 193-216 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The treatment of the finite width and the inelastic effects previously proposed for the $\rho$ case is extended to the $\omega$-$\phi$ case. This leads to a complex, and energy dependent $\omega$-$\phi$ mixing formalism. Applications are given to computing $\rho$, $\omega$, and $\phi$ interference effects and their high energy tails in $e^+e^- \to 2\pi$, $3\pi$, $K\bar{K}$, $\pi\gamma$ and $\eta\gamma$. The possible existence of higher vector mesons is considered in an ideal nonet structure similar to the ordinary vector meson structure. Using $SU_3$ and the quark model relations, the coupling constants and width of the members of the first two nonets V' and V'' are predicted. Their effects ($\rho$-$\rho'$ mixing included) are shown in the reactions $e^+e^- \to 2\pi$, $3\pi$, $K\bar{K}$, $\pi\gamma$ and $\eta\gamma$. The asymptotic behavior of the total cross section ($e^+e^- \to$ hadrons) is discussed in connection with the existence of the infinite series of vector mesons. The possibility of the limiting case where a strong mixing of many overlapping states occurs is emphasized. (FR)

**13299** COLLECTIVE RESONANCE PHENOMENON IN HADRONIC SYSTEMS. Kuzmin, V. A.; Lobashev, V. M.; Tavkhelidze, A. N. (AN SSSR, Moscow. Inst. Yadernykh Issledovanij); Matveev, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 57: No. 5, 467-469(4 Aug 1975).

A possibility of existence of collective vibrations in hadronic matter and some feasible implications are discussed. Within the framework of a quark model where such vibrations could occur the behavior of $e^+e^-$-annihilation cross-section into hadrons is explained as a consequence of collective effects in analogy with the giant resonance phenomenon in nuclear photoabsorption reactions. (auth)

**13300** $e^+e^-$ ANNIHILATION SCALING PLATEAUS FROM FINITE ENERGY SUM RULES. Barger, V.; Long, W. F.; Olssen, M. G. (Wisconsin Univ., Madison (USA). Dept. of Physics). Phys. Lett., B; 57: No. 5, 452-454(4 Aug 1975).

Using recent data from SPEAR on $R(s) = \sigma\dagger(e^+e^- \to \gamma \to \text{hadrons})/\sigma_{QED}(e^+e^- \to \mu^+\mu^-)$ finite energy sum rule (FESR) constraints on scaling behavior are evaluated. It is found that two scaling plateaus are required to satisfy the FESR: $R(s) = 2.1 \pm 0.3$ for $\sqrt{s} < 3$ and $R(s) = 4.8 \pm 0.4$ for $\sqrt{s} > 3$ GeV. (auth)

**13301** PHENOMENOLOGY OF NEUTRAL CURRENTS MEDIATED BY A LIGHT VECTOR BOSON. Missimer, J.; Wolfenstein, L. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). Nucl. Phys., B; 94: No. 2, 189-196(11 Aug 1975).

The phenomenology of neutral currents for inclusive neutrino reactions and $e^+e^-$ annihilation is discussed for the case of an intermediate vector boson with a mass between 3 and 6 GeV. It is shown that present data on neutrino reactions do not preclude such a light mass. If $\psi$ and $\psi'$ are not coupled to neutrinos, the non-existence of other narrow resonances rules out a mass in this range if the boson has a significant coupling to electrons. (auth)

**13302** CONFINED QUARKS AND ASYMPTOTIC $e^+e^-$ ANNIHILATION. Osborn, H. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Phys. Lett., B; 58: No. 1, 111-113(18 Aug 1975).

In a version of the massive quark model due to Polkinghorne it is shown that the asymptotic behaviour of $R = \Sigma_{e^+e^- \to \text{hadrons}}$ $\Sigma_{e^+e^- \to \mu^+\mu^-}$ is the same as in the naive quark parton model, where the quarks appear to be produced in the final state. (NL)

**13303** LONGITUDINAL PHOTONS IN THE FIREBALL. Murphy, G. L. (Westminster Coll., New Wilmington, PA). Nature (London); 257: No. 5522, 159-160(11 Sep 1975).

Reference is made to Byrne and Burman (Nature 253:27 (1975)) who discussed the significance of astrophysical data for the problem of the photon mass. A question discussed is the possible presence of longitudinal photons in the microwave background where photon mass is not zero. In true thermal equilibrium the longitudinal modes of the field would have to be populated to the same extent as the transverse modes. Millions of years would be required for an appreciable fraction of longitudinal photons to build up in terrestrial situations, but such time intervals are available cosmologically. Expressions are given for the emission of longitudinal and transverse vector mesons of given wave number in a given process and for the fraction of transverse photons converted into longitudinal photons per second. The results are applied to photons of a fireball moving through $H_2$. The fraction of longitudinal photons is found to be negligible even after many times $10^{10}$ years. (UK)

**13304** ELECTROMAGNETIC INTERACTIONS OF KAONS. Pervushin, V. N.; Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). Phys. Lett., B.; 58: No. 2, 177-179(1 Sep 1975).

For neutral and charged kaons the electromagnetic form factor, mean-square radius, amplitude of the Compton effect and polarizability are calculated within the chiral quantum field theory. (NL)

## Weak

*Refer also to abstracts 12860, 13145, 13186, and 13870.*

**13305** (INIS-mf-1727) PARTIAL WIDTHS OF BARYONIC DECAYS WITH PION EMISSION. do Monte Lima, I. (Sao Paulo Univ. (Brazil). Instituto de Fisica). Nov 1973. 46p. (In Portuguese). INIS.

The problem of baryon resonance widths is examined from the point of view of a harmonic and symmetric quark model. First is studied the kinematics of colinear systems. Next the partial baryonic decay widths with pion emission are calculated; configuration mixing is discussed. Finally, the choice of parameter is presented, and results are compared with previous work. Fundamental characteristics of the approach used are: nonrelativistic treatment of the $SU(6) \times O_L(3)$ group, and the introduction of the $M^2$ operator, which leads to linear Regge trajectories. (auth)

**13306** (JINR-R-2-8207) NEUTRINO EXPERIMENTS AND NON-LOCAL THEORY OF WEAK INTERACTIONS. Zibol'd, K.; Malyshkin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1974. 12p. (In Russian). INIS.

14 refs.; 1 fig.

Within the framework of nonlocal theory of weak and electromagnetic interactions, the cross sections of $\nu_e$ and $\nu_e$ scattering were calculated. The calculations were limited to the order $G^2$ and $G\alpha\alpha$ is the fine structure constant, G is the Fermi coupling constant). Comparison of the calculated results with data from earlier experiments on $\nu_e e$-$\nu_\mu e$ scattering gave firm boundaries on unknown parameters of the theory (charged neutrino radius and elementary length). (INIS)

**13307** (RL-75-151) NEUTRINO AND ANTINEUTRINO SCATTERING BY ELECTRONS, AND BY PARTONS. Bell, J. S.; Dass, G. V. (European Organization for Nuclear Research, Geneva (Switzerland); Science Research Council, Chilton (UK). Rutherford Lab.). Sep 1975. 7p. Dep. NTIS (US Sales Only) $4.25.

Assuming a nonderivative point interaction and Born approximation, there are some simple relations between neutrino and antineutrino scattering on electrons or partons. They have been observed already, for some special cases, in the results of explicit calculations. They are obtained from simple general considerations. (auth)

**13308** (RL-75-165) GENERAL RELATIONS BETWEEN NEUTRINO AND ANTINEUTRINO SCATTERING. Dass, G. V. (Science Research Council, Chilton (UK). Rutherford Lab.). Oct 1975. 10p. Dep. NTIS (US Sales Only) $4.25.

Assuming the Born approximation and that the neutrino covariants in the interaction are nonderivative, one obtains some simple relations between neutrino and antineutrino scattering on any target; the scattering may be elastic, inelastic, or deeply inelastic. Some of these relations were noted already in some special cases by making stronger assumptions and sometimes only by explicit calculation. The derivations rest only on simple general considerations. (auth)

**13309** PHENOMENOLOGY OF QUASI-ELASTIC NEUTRINO PRODUCTION OF CHARMED BARYONS. Gatto, R. (Univ., Rome); Vendramin, I. Lett. Nuovo Cim.; 14: No. 13, 489-492 (29 Nov 1975).

The introduction of a new quark of charge $\frac{2}{3}$ and bearing a new quantum number, charm, was proposed in connection with the new resonances. A phenomenological discussion is given of the implications of the V,A current for quasi-elastic neutrino productions of singly charmed baryons. The predictions of various models for the cross sections for charmed particle production are discussed. (JFP)

**13310** INCLUSIVE NEUTRINO AND ANTINEUTRINO REACTIONS AND CHARGED CURRENTS. Gourdin, M. (Paris-6 Univ., 75 (France). Lab. de Physique Theorique et Hautes Energies). pp 21-50 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The theoretical framework for a phenomenological analysis of high energy processes induced by neutrinos and antineutrinos is presented. Only the case of charged currents is considered. A special emphasis is given to charge symmetry and the parameters of the quark parton model are computed. (FR)

**13311** LEPTON AND HADRON STRUCTURE. Volume 12. 1974 International School of Subnuclear Physics, Erice, Italy, July 14–31, 1974. Zichichi, A. (ed.). Subnuclear series. London; Academic Press Inc. (1975). 960p. (CONF-740731-). $49.00.

From international school of subnuclear physics; Erice, Italy (14 Jul 1974).

The conference contained 32 papers. Separate abstracts were prepared for 31 papers. One paper was outside the scope of NSA. (JFP)

*For abstracts of individual papers see: 12711, 12781, 13149–13151, 13228–13233, 13288–13293, 13312–13315, 13332–13334, 13362, 13382, 13416, 13419, 13716, 13717, and 13852.*

**13312** ARE LEPTONS REALLY DIFFERENT FROM HADRONS. Salam, A. (International Centre for Theoretical Physics, Trieste, Italy). pp 2-19 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

A model pointing to a basic identity between the baryonic and leptonic worlds is considered including the historical development of ideas, consequences of the unification scheme, gauging of $SU_L(4) \times SU_R(4) \times SU(4')$, a variant to the basic model, quark and proton–neutron decays into leptons, and the strength of strong interactions and unification with gravity. (JFP)

**13313** INTERACTION OF NEUTRINOS WITH NUCLEONS. Burhop, E. H. S. (Univ. College, London). pp 376-421 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The discussion of neutrino interactions with nucleons covers neutrino beams from accelerators, detectors of neutrino interactions, elastic neutrino interactions, deep inelastic scattering of electrons and neutrinos, sum rules, measurement of the total cross sections for $\nu$ and $\bar{\nu}$ interactions, an estimation of mean square momentum transfer, determination of structure functions, the parton momentum distribution, sum rule tests and the quark–parton model, pion charge ratio in neutrino interactions, and conclusions from neutrino deep inelastic scattering studies. (JFP)

**13314** MUON–NUCLEON SCATTERING: SEARCH FOR HADRON AND LEPTON STRUCTURE. Heusch, C. A. (Univ. of California, Santa Cruz). pp 650-670 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

A few aspects of what can be learned from a detailed study of final-state particles of deeply inelastic lepton-nucleon scattering are studied. Results on the relative cross sections for one, three, ... charged hadrons in the final state and average charged multiplicities for the processes $mu^+p$ are presented. It is noted that a number of intriguing features are beginning to emerge from precision studies of hadronic final states in lepton–nucleon scattering. (JFP)

**13315** WEAK SPIN ROTATION EFFECTS. Stodolsky, L. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). pp 766-774 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

Weak spin rotation effects are discussed for the neutron optics, cold neutrons in bismuth, neutron reactions, beam longitudinal polarization, and the neutrino sea in cosmology. (JFP)

**13316** INTRODUCTION TO WEAK NEUTRAL CURRENTS. Fayet, P. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique Theorique et Hautes Energies). pp 87-109 of Interactions Leptoniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The question of weak neutral currents is presented in connection with the unified gauge theories of weak and electromagnetic interactions. (FR)

**13317** FINAL-STATE INTERACTIONS WITH INELASTIC EFFECTS IN NON-LEPTONIC HYPERON DECAYS. Bhamathi, G. (Texas Univ., Austin (USA). Center for Particle Theory); Raghavan, S. (Madras Univ. (India). Dept. of Theoretical Physics). Nucl. Phys., B; 95: No. 2, 357-364(1 Sep 1975).

A recent work by Reid and Trofimenkoff seemed to indicate that a satisfactory model using current algebra, PCAC and the soft-pion limit can be formulated to obtain the s- and p-wave amplitudes of the non-leptonic decays of $\Lambda$ and $\Sigma$, as well as the $\Delta I = \frac{1}{2}$ rule if final state interactions are included. In this paper it is demonstrated that by including inelastic effects in the final-state interactions (that is without the usual approximation of elastic unitarity) the results bring one back full circle. The disagreement between theory and experiment for the p-wave amplitudes still persists and no significant suppression of the $I = \frac{3}{2}$ state for the final particles can be predicted. (auth)

**13318** RADIATIVE CORRECTIONS TO SEMILEPTONIC DECAYS OF CHARGED HYPERONS. Suzuki, S.; Yokoo, Y. (Osaka Univ., Toyonaka (Japan). Dept. of Physics). Nucl. Phys., B; 94: No. 3, 431-444(18 Aug 1975).

The radiative corrections to the lepton energy spectrum in semileptonic hyperon decays have been studied. The calculation is performed relativistically for the baryons as well as for the leptons, under the assumption of the effective current-current interaction of the $V-\rho A$ type for the baryonic part. The explicit formula of radiative corrections to the lepton energy spectrum is obtained which can be exactly evaluated in case of charged hyperon decays. Numerical values of the radiative corrections to the decay rate and the shape of the lepton energy spectrum are also given for some decay modes. It is shown that the spectral shape is little affected by the radiative corrections. (auth)

**13319** OPEN QUESTIONS IN K DECAY. Gaillard, M. K. (European Organization for Nuclear Research, Geneva (Switzerland)). Acta Phys. Slovaca; 24: No. 3, 132-166(1974).

From triangle meeting on weak interactions; Smolenice, Czechoslovakia (4 Jun 1973).

The $K_{e3}$ decay is considered with a view to the origin of the $|\Delta I| = \frac{1}{2}$ rule while the $K_{\mu 3}$ decay is considered with a view to the breaking of chiral symmetry. The $K_{e4}$ and $K_{\mu\mu}$ decays are also commented on. Various isospin amplitudes are extracted from the existing data on nonleptonic decays, and ambiguities arising from electromagnetic mass differences are displayed. The $|\Delta I| = \frac{3}{2}$ amplitudes are compared with the pole contribution and with current algebra predictions. The extrapolation of the soft pion theorem for $K_{\mu 3}$ to the physical region is discussed. The bounds are given for the divergence form factor as a function of chiral symmetry breaking parameters under the assumption of twice subtracted scalar and pseudoscalar propagators. (auth)

**13320** HYPERFINE VALUES MEASURED AT POSITIVE MUONS IN METALS. Meier, P. F. (Swhweizerisches Inst. fuer Nuklearforschung, Villig). Solid State Commun.; 17: No. 8, 987-989(15 Oct 1975).

The enhancement of conduction electron density at the position of a positive muon implanted into a metal is calculated in a simple model. Some problems in the interpretation of muon spin frequencies in ferromagnets are pointed out. (auth)

**13321** INFRARED PROBLEMS IN MUON DECAY. Marciano, W. J. (Rockefeller Univ., New York (USA). Dept. of Physics); Marques, G. C.; Papanicolaou, N. (New York Univ., N. Y. (USA). Dept. of Physics). Nucl. Phys., B; 96: No. 2, 237-254(22 Sep 1975).

Radiation corrections to $\mu$-decay are calculated in the context of the coherent states formulation of the asymptotic condition by using dimensional regularization techniques. The theoretical explanation of radiation camping phenomena at the end-point of the decay spectrum is also clarified. (NL)

**13322** NEUTRINO-PRODUCTION OF CHARMED BARYONS. Finjord, J.; Ravndal, F. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Phys. Lett., B; 58: No. 1, 61-63(18 Aug 1975).

Cross-sections for neutrino-production of the three lowest conjectured charmed baryons are calculated from a relativistic quark model. (NL)

**13323** EFFECTIVE MECHANISM FOR CHARMED PARTICLE PRODUCTION IN NEUTRINO AND ANTINEUTRINO BEAMS. Arbuzov, B. A.; Gershtein, S. S.; Folomeshkin, V. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). Phys. Lett., B; 58: No. 1, 64-66(18 Aug 1975).

The paper describes an effective mechanism for charmed particle production in neutrino and antineutrino reactions, which consists in production of charmed virtual $\bar{F}^*$-meson in a weak

vertex $\nu F^* \mu$ (without suppression by the Cabibbo angle) with further strong rescattering of $F^*$-meson on nucleon. This "quasi-diffractive" mechanism should make the basic contribution to the production of charmed particles in neutrino experiments basic energies up to some hundreds of GeV. The charmed particles are mainly produced at limited momentum transfers mod($q^2$) approximately $M^2_{F^*}$ and with equal cross sections in the neutrino and antineutrino beams. (NL)

**13324** UNITARITY CORRECTIONS TO OKUBO ANSATS OR ZWEIG'S RULE. The Decay Mode $\psi \to \rho\pi$. Pasupathy, J. (Tata Inst. of Fundamental Research, Bombay (India)). Phys. Lett., B; 58: No. 1, 71-73(18 Aug 1975).

Unitarity corrections to strong decays of $\psi$ are estimated using dispersion relations and dual model with SU(4) symmetric couplings. For $\psi \to \rho\pi$ a suppression factor approximately $3 \times 10^{-4}$ for $m_{D^*} = 2$GeV is found. Consequences of the model for $\psi \to \varphi\pi\pi$, radiative decays and $\psi' \to$ ordinary hadrons are pointed out. (NL)

**13325** IS THERE AN ETHER. Dudley, H. C. (Univ. of Illinois, Chicago). Ind. Res.; 16: No. 12, 41-46(15 Nov 1974).

The current Information Explosion requires critical reevaluation of several long-accepted paradigms: interstellar and interplanetary electric and magnetic fields contribute to forces acting between celestial bodies; radioactivity has been shown to be influenced by energy state of orbital electrons, requiring critical reexamination of presently accepted concepts of mechanisms of all so-called "nuclear" reactions; concepts of a generalized, energy-rich subquantic medium, a particulate ether, have developed, such that all projections of nuclear safety need to be critically and open-mindedly evaluated. (auth)

## *Strong (General)*

**13326** (IFVE-STF-74-100) QUARK MODEL PREDICTIONS AND PRODUCTION OF VECTOR RESONANCES OR STRANGE PARTICLES IN THE CENTRAL REGION. Anisovich, V. V.; Kobrinsky, M. N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1974. 10p. INIS.

9 refs.; 1 table.

Predictions from quark models for hadron-hadron collisions were compared with experimental data. With a small longitudinal momentum of inclusive reactions, all predictions from the quark model agreed well with experimental data. This model predicts meson and baryon ratios accurately. (tr-auth)

**13327** (IFVE-STF-74-102) ONE-PARTICLE DISTRIBUTION IN THE OPTICAL MODEL. Savrin, V. I.; Semenov, S. V.; Tyurin, N. E.; Khrustalev, O. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1974. 10p. INIS.

A relation was established between the inclusive distribution of transverse momentum of formed particles and characteristic angular distribution of colliding hadrons. A generalization was made, and further work was done on developing the optical model independent of the emission of soft pions. (tr-auth)

**13328** (JINR-P1, 2-8529, pp 295-373) POLARIZATION PHENOMENA AT SMALL TRANSMITTED MOMENTA. Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The importance of studying the role of polarization phenomena is discussed in general before an analysis of specific polarization phenomena. The areas discussed are the scattering of neutrons by nuclei and the Coulomb field of the nucleus, scattering of mesons by nucleons, relative phase of the amplitude, polarization effects in small angle scattering, polarization of high energy baryons during their small-angle scattering by nuclei, scattering of protons and charged hyperons, scattering of neutrons (neutral baryons) by protons, polarization experiments in p-p collisions at high energy, and polarization effects in coherent production of unstable particles and the Primakov effect. (JSR)

**13329** PROCEEDINGS OF THE 3RD INTERNATIONAL WINTER MEETING ON FUNDAMENTAL PHYSICS HELD AT SIERRA NEVADA, SPAIN, FEBRUARY 10-15, 1975. Bejarano, J. D.; Doncel, M. G. (ed.). Madrid; Instituto de Estudios Nucleares (1975). 594p. (CONF-750242-).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975).

Separate abstracts were prepared for the 18 papers presented. (JFP)

*For abstracts of individual papers see: 13134, 13157-13159, 13181-13184, 13259, 13275, 13351-13354, 13377, 13378, 13397, and 13437.*

**13330** LAWS OF HADRONIC MATTER. Conference Held at Erice, Trapani, Sicily, July 8-26, 1973. Zichichi, A. (ed.). Subnuclear Series Volume 11. London; Academic Press Inc. (1975). 928p. (CONF-730755-). $49.00.

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973).

Separate abstracts were prepared for the 25 papers presented. (JFP)

*For abstracts of individual papers see: 12910, 13124, 13145, 13146, 13160, 13161, 13195, 13209-13212, 13276-13278, 13331, 13355-13358, 13413, 13414, 13438, 13846, 13847, and 13907.*

**13331** LECTURE II: FROM ARGAND DIAGRAMS TO PHYSICS. Rosenfeld, A. H. (Univ. of California, Berkeley). pp 492-509 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

A lecture is given in which the physics which one can learn from the Argand plots is treated. Included are a comparison of $\gamma p \to \pi N$ and $\pi N \to \rho N$ with the quark model, SU(3) tests: $\pi N \to \Delta\pi$ vs $\bar{K}N \to \Sigma(1385)\pi$, comparison of $\Delta\pi$ amplitudes with SU(6) and the quark model, estimating resonance parameters by eye without a K matrix, multichannel K matrix and T matrix fits, unitary (Breit-Wigner and background) fits to the T matrix, and results from the different resonance parametrizations. (JFP)

**13332** MODELS OF HIGH ENERGY HADRONIC INTERACTIONS: WHAT IS THE POMERON. Low, F. E. (Massachusetts Inst. of Tech., Cambridge). pp 22-53 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

A discussion is given of why almost all cross sections are approximately constant over many decades of energy variation. Single pomeron exchange only is considered. The Regge pole picture of the pomeron, the pomeron as double exchange of an elementary but observable vector meson, and the pomeron as the double exchange of unobservable elementary gauge fields in the framework suggested by the bag model are treated. (JFP)

**13333** POSSIBLE WAY TO LOOK AT HADRONS: THE MASSIVE QUARK MODEL. Preparata, G. (CERN, Geneva). pp 54-133 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

A possible quark field theory is discussed in which the limit $M_Q \to \infty$ is taken. In such a theory the quarks have disappeared from the Hilbert space of physical states and appear in nature only when one probes in one way or another the hadrons in space-time domains of the order of 1 F. The basic ideas of the quark description of hadrons, in particular a discussion of the dynamical aspects of quark interactions, Regge behavior, and a perturbative scheme, electromagnetic and deep inelastic phenomena, and hadronic scattering at large transverse momenta are considered. (JFP)

**13334** TWO TOPICAL QUESTIONS ON HIGH ENERGY HADRON COLLISIONS: DIFFRACTIVE EXCITATION AND LARGE TRANSVERSE MOMENTUM PHENOMENA. Jacob, M. (CERN, Geneva). pp 482-539 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The key features of processes in which one sees either a secondary particle with a transverse momentum of particularly large value or a secondary particle with identical quantum numbers as those of one of the incident particle and with a momentum very close ratio-wise to that of this incident particle are reviewed. The diffractive signature the triple-Regge formalism, angular dependence of diffractive excitation, the hadronic nova, the Deck effect at the ISR, inclusive yields at large transverse momentum, particle ratios, dynamics of large $p_T$ phenomena, and correlations involving a large $p_T$ particle are discussed. (JFP)

**13335** STUDY OF THE INCLUSIVE PRODUCTION OF $\Lambda^0$ AND $\bar{\Lambda}^0$ IN $K^+p$ INTERACTIONS AT 8.2 AND 16 GeV/c. Grard, F. (Mons Univ. (Belgium)). pp 473-491 of Interactions Ha-

droniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Single particle inclusive distributions of $\Lambda^0$ and $\bar{\Lambda}^0$ produced in $K^+p$ interactions at 8.2 and 16.0 GeV/c are presented. The data are compared with the existing published data on the same reactions at 12.7 GeV/c and on $\Lambda^0$ productions in pp interactions, to test the limiting fragmentation and factorization hypothesis. (FR)

**13336** STRONG INTERACTIONS AT VERY HIGH ENERGY. Paty, M. Recherche (Paris); 6: No. 52, 57-60(Jan 1975). (In French)

Strong interactions in the very high energy field are studied. The main facts broached fall into three groups: the total cross section behavior, the multiplicity of particles produced in the collisions and the characteristics of the collision core, i.e. the study of particles formed with a strong transverse momentum, that most concerned by the parton model. (FR)

**13337** LARGE TRANSVERSE MOMENTUM PHENOMENA: AN EXPERIMENTAL AND THEORETICAL REVIEW. Ellis, S. D. (European Organization for Nuclear Research, Geneva (Switzerland)); Thun, R. (State Univ. of New York, Stony Brook (USA)). pp 37-74 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

A review is presented of both experimental and theoretical results on large transverse momentum inclusive processes. The experimental topics include single-particle cross-sections, particle composition and correlations at large transverse momentum. The characteristics and predictions of the various theoretical models are described. The similarities and differences between the models are discussed with emphasis on those features which allow experimental discrimination. (FR)

**13338** DIFFRACTIVE DISSOCIATION AS SHADOW OF HADRONIC BREMSSTRAHLUNG. Bialas, A. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). pp 353-362 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

A summary of the papers on mechanism of diffraction dissociation from nucleons and from nuclei, written recently in collaboration with A. Kotanski and W. Czyz, is presented. (FR)

**13339** COMMENTS ON DIFFRACTION PROCESSES AND TOTAL CROSS SECTIONS. Morrison, D. R. O. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 275-297 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Recontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Some controversial aspects of diffraction dissociation are discussed in the light of some recent results. Evidence is presented that the $A_1$, $A_3$, Q and L mass enhancements are not single resonant states and that an $N^*(1400)$ is not required. It is suggested that the cross section for diffraction dissociation is almost equal to that for diffraction elastic scattering and both are slowly rising as does the total inelastic cross section, i.e., as $s^{+0.04}$ or $(\log s)^{+0.04}$. The Reggeon exchange part of pp elastic scattering then falls as $s^{-1}$. (FR)

**13340** IMPACT STRUCTURE OF DIFFRACTION SCATTERING. Miettinen, H. I. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 363-402 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Some recent progress in the impact analysis of elastic and inelastic diffraction is discussed. Remarks are made on some theoretical explanation of the total cross-section rise. (FR)

**13341** MULTIPLICITY DISTRIBUTION IN IMPACT PARAMETER SPACE. Sakai, N. (Max-Planck- Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). pp 435-443 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The formulation of inclusive overlap functions which give multiplicity distributions at incident impact parameter b is summarized. Several models of multiperipheral type are discussed. It is pointed out that the dependence of the momentum-transfer slope upon subenergies is important in knowing which collision, central or peripheral, has higher multiplicity. (FR)

**13342** $e^+e^-$: SIX OR MORE PIONS IN SEARCH OF A THEORY. Rubinstein, H. R. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 181-192 of Interactions Hadroniques a Hautes Energies. Vol. II. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

A few models of hadronic annihilation of electrons and positrons are discussed: models with a large number of opening thresholds such as one recently developed by Ferro Fontan and the author, and the nucleon-antinucleon analogue model. New observations on both models are reviewed. The renormalization group and its genetic changes under the new environment produced by Frascati, CEA and SPEAR, are then discussed. (FR)

**13343** FINITE-ENERGY CORRECTIONS AND MULTIPLICITY FLUCTUATIONS ACCORDING TO THE GOTTFRIED MODEL OF HADRON-NUCLEUS INTERACTIONS. Andersson, B. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 95: No. 2, 237-248(1 Sep 1975).

Finite-energy corrections and multiplicity fluctuations are considered in the Gottfried model for hadron-nucleus high-energy interactions. The results are that there are appreciable corrections at Serpukhov-NAL energies, such that the Gottfried parameter is $\eta = 0.25$–$0.27$ instead of e.g. $\eta = 0.38$ in better agreement with presently available experimental results for proton-nucleus collisions. Further, the sensitivity of the model to some of the input parameters results in appreciable fluctuations in multiplicity, the multiplicity distribution of the part stemming from repeated collisions inside the nucleus being at least as broad as a Poisson distribution. (auth)

**13344** RANDOM WALK OF DECAYING HADRON FIREBALLS. Noteva, V.; Torsti, J. J. (Turku Univ. (Finland). Wihuri Physical Lab.). Phys. Lett., B; 58: No. 2, 194-196(1 Sep 1975).

Three-dimensional momentum distributions of decaying fireballs and the resulting inclusive pion spectra are calculated by using two different statistical bootstrap models. (NL)

**13345** SPIN PARITY OF A $p\omega$-ENHANCEMENT NEAR 1800 MeV. Lednicky, R. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 58: No. 1, 89-92(18 Aug 1975).

Recently a threshold $p\omega$ enhancement at 1800 MeV was observed in several reactions of the type $ap \to ap\omega$ claimed to be probably an s-wave object with the spin $J = 1/2$ or $3/2$. It is shown here that this enhancement has spin parity $3/2^-$ and that, in the production process $ap \to ap\omega$, the t-channel helicity is approximately conserved. (NL)

**13346** DUALITY AND PARITY DOUBLETS. Storrow, J. K. (Science Research Council, Daresbury (UK). Daresbury Lab.). Nucl. Phys., B; 96: No. 1, 77-89(15 Sep 1975).

The possibility of obtaining information on the baryon spectrum from high-energy amplitude analyses via duality is examined, with particular reference to the possible existence of parity doublets. Information is obtained by direct construction of the amplitudes and indirectly, by examination of the sign of the ratio of the imaginary parts of the flip and no-flip amplitudes. It is found that current analyses are consistent with the absence of parity doublets. Implications for models are discussed. (NL)

**13347** ENERGY-DEPENDENT PARTIAL-WAVE ANALYSIS OF $\pi N \to K\Sigma$. Deans, S. R.; Mitchell, R. W.; Montgomery, D. L.; Wood, G. C. (Department of Physics, University of South Florida, Tampa, Fl. USA); Rush, J. E. (Alabama Univ., University (USA). Dept. of Physics). Nucl. Phys., B; 96: No. 1, 90-108(15 Sep 1975).

An energy-dependent partial-wave analysis of the isospin-coupled reactions $\pi^+p \to K^+\Sigma^+$, $\pi^-p \to K^0\Sigma^0$, and $\pi^-p \to K^+\Sigma^-$ from threshold to 2310MeV c.m. energy has been performed. Argand plots of the amplitude and the product of the branching ratios to $\pi N$ and $K\Sigma$ for several $N^*$ and $\Delta$ resonant states are obtained. In the best solution there are resonant $F_{15}$ and $S_{31}$ states between 1900 and 2000 MeV and a $D_{13}$ around 1700 MeV, in addition to other well-known resonant states. (NL)

## Strong (Baryon No. = 0)

*Refer also to abstract 13184.*

**13348** (COO-1764-237) EXOTIC N anti N RESONANCES. Rosner, J. L. (Minnesota Univ., Minneapolis (USA). School of Physics and Astronomy). 1975. Contract AT(11-1)-1764. 14p. (CONF-750749-1). Dep. NTIS $4.50.

From symposium on new directions in hadron spectroscopy; Argonne, Illinois, USA (8 Jul 1975).

Some possible suggestions for detecting exotic anti NN resonances are reviewed including the size of Reggeon-exchange contributions to baryon-anti baryon total cross sections, the smallness of S-wave annihilation rates, and the goodness of asymmetry description of N anti N annihilations at rest. (JFP)

**13349** (FRNC-TH-531) DETERMINATION OF $K\pi$ CROSS SECTIONS USING EXTRAPOLATION METHODS. Benkheiri, P. (Paris-6 Univ., 75 (France)). 1971. vp. (In French). INIS.

Thesis.

A conformal transformation was introduced in the Chew-Low extrapolation method and the effect of such a procedure on the closeness of the information transfer from the physical region to the pole due to one-pion exchange was experimentally tested in view of obtaining the $K\pi$ elastic scattering cross section. The theoretical reasons for using a conformal transformation are recalled. The results obtained for the following reactions at 3 GeV/c lab. are presented: $K^- + p \rightarrow K^- + \pi^+ + n$ and $K^- + d \rightarrow K^- + \pi^- + p + p_S$. It seems that the use of such techniques are experimentally justified. (FR)

**13350** (JINR-E2-9211) EFFECT OF THE BOSE-STATISTICS ON AZIMUTHAL CORRELATIONS. Kopylov, G. I. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 17p. Dep. NTIS (US Sales Only) $4.50.

A simple explanation is given to the fact that the azimuthal angles between like pions are distributed not so as between unlike pions. Azimuthal angular distributions, asymmetry coefficients of the distributions, their dependence on multiplicity and transverse momentum are calculated. It is shown that one can estimate the space-time parameters of multiple production processes by measuring the difference between the azimuthal correlations of $\pi^+\pi^+$ and $\pi^+\pi^-$ pairs. (auth)

**13351** THEORIST'S VIEWPOINT ON NEW $\psi$ PARTICLES. de Rafael, E. (CNRS, Marseille). pp 53-56 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

A brief bibliography is given on the $\psi$ particles. (JFP)

**13352** THEORETICAL EVALUATION OF MESON-MESON PHASE SHIFT ANALYSIS AND SCALAR RESONANCES. Yndurain, F. J. (Univ., Madrid). pp 183-212 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

The problems associated with phase shift analysis of the processes $\pi\pi$, $\pi\pi \rightarrow K\bar{K}$, and $K\bar{K}$ are reviewed; particularly in connection with scalar resonances. (auth)

**13353** $1^+$ SPECTROSCOPY: FACT, FANTASY, AND FUTURE. Dainton, J. B. (Daresbury Lab., Eng.). pp 235-259 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

The evidence existing for $I = \frac{1}{2}$ and 1 axial vector meson production is extracted in suitably controversial fashion, and is discussed where, why, and how one should expect to find more conclusive evidence for these states. (JFP)

**13354** PREDICTIONS OF A REGGE POLE MODEL WITH FACTORIZED RESIDUES FOR THE REACTION $p\bar{p}$ YIELDS $\Delta\bar{\Delta}$. Enflo, B. O.; Frick, I. (Univ., Stockholm). pp 261-275 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

Relations among the resonance decay parameters in the reaction $p\bar{p} \rightarrow \Delta\bar{\Delta}$ are given, which hold for a Regge pole model with factorized residues. Those combinations of the residues are given, which are measurable in an unpolarized experiment. (auth)

**13355** RECENT DEVELOPMENTS OF DUAL MODELS. Frampton, P. H. (CERN, Geneva). pp 112-136 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

It was indicated how the symmetric group plays a central role in the make-up of meson tree amplitudes. By exploiting this fact, one has classified earlier proposals for the Born amplitude. A new four-pion and N-pion amplitude were explicitly constructed, and a first discussion was made of its properties. (JFP)

**13356** CURRENT STATUS OF MESON SPECTROSCOPY. Miller, D. H. (Purdue Univ., Lafayette, IN). pp 378-467 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

A review is given of the current status of meson spectroscopy and is basically composed of results published between January 1972 and Jun 1973. Some historical perspective is included together with indications of future directions. (JFP)

**13357** ALMOST EVERYTHING ABOUT BARYON RESONANCES. Rosenfeld, A. H. (Univ. of California, Berkeley). pp 468-491 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

The review of baryon resonances is restricted to nonstrange baryon resonances and covers recent doubling of information, partial wave analysis of $\pi N \rightarrow N\pi\pi$, the connection between energies and to elastic partial waves, counting and naming the waves, checks of the LBL/SLAC programs, and results for Argand diagrams for 1972 solution only. (JFP)

**13358** MESON DAUGHTERS: REALITY OR FICTION. Montanet, L. (CERN, Geneva). pp 510-554 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

The discussion of meson daughters covers Regge trajectories for mesons, Regge daughter trajectories, Veneziano's daughters, the $G = +1$ and $-1$ natural parity systems, the unnatural parity system, and the $I = \frac{1}{2}$ mesons. (JFP)

**13359** RECENT DETERMINATIONS OF CHIRAL SYMMETRY BREAKING. Furlan, G.; Paver, N. (Istituto de Fisica Teorica, Trieste, Italy). Acta Phys. Austriaca; 40: No. 2, 119-132(1974).

From an analysis of a few indicative processes, it is found that the simple $(3,\bar{3}) + (\bar{3},3)$ quark scheme of chiral breaking seems to allow an improved description of soft pion theorems. Using a simple extrapolation technique, indications on the properties of the current quarks and compatibility from $\pi - \pi$ were obtained. This should confirm that it is useful and natural to consider a description of low energy pion phenomena based on the notion of approximate chiral $SU(2) \times SU(2)$. (JFP)

**13360** THEORETICAL EXPRESSION FOR THE $\rho$ AND $A_1$ MASSES. Madore, J. (Institut Henri Poincare, Paris). Lett. Nuovo Cim.; 14: No. 11, 385-389(15 Nov 1975).

It is shown that if one introduces into the sigma model massive vector and axial-vector mesons such that the resulting Lagrangian is invariant under local transformations of the chiral group $SU(2) \times SU(2)$, is polynomial, and has no derivative couplings except between the (pseudo-) scalar and (axial) vector mesons, then the (bare) masses of the vector and axial vector mesons are uniquely determined. (JFP)

**13361** S-WAVE RADIAL EXCITATIONS FOR A LINEAR POTENTIAL. Ferreira, P. L.; Alcaras, J. A. C. (Inst. of Theoretical Physics, Sao Paulo, Brazil). Lett. Nuovo Cim.; 14: No. 13, 500-504(29 Nov 1975).

An elementary study is made of S-wave bound states for the interpretation of the psi particles. After deriving the energy spectrum and the corresponding normalized eigenfunctions, one obtains, in an analytical way, a number of properties of the bound-state solutions, related to the expectation values of physical quantities which are of interest in physical applications. They correspond to integrals involving Airy functions which, as far as is known, are not found in the mathematical literature. (JFP)

**13362** IS VECTOR DOMINANCE STILL ALIVE. Schildknecht, D. (Deutsches Elektronen-Synchrotron, Hamburg).

pp 448-481 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

Some new results recently obtained within the framework of off-diagonal generalized vector dominance are presented including $\rho^0$, $\omega$, and $\phi$ dominance and hadronlike behavior of the photon, generalized vector dominance, the diagonal model and its problems, and a model with inclusion of off-diagonal transitions, recent $e^+e^-$ annihilation data implications for violations of scaling in deep inelastic electron scattering, and vector meson electroproduction off-diagonal transitions as a model for photon shrinkage. (JFP)

**13363** PRODUCTION MECHANISMS FOR HIGH MASS RESONANCES. Michael, C. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 147-152 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

For a sequence of resonance states of increasing spin and mass which lie on a given Regge trajectory, the two-body production mechanisms are compared. Duality provides relations between the respective couplings and an explicit dual model vertex structure is shown to relate $\pi N \to \rho N$ and $\pi N \to f_0 N$ amplitudes. (FR)

**13364** RIGOROUS ABSOLUTE BOUNDS FOR PION-PION SCATTERING. III. Dispersion Relations on Algebraic Manifolds and Computation of Bounds. Auberson, G.; Epele, L.; Mahoux, G.; Simao, F.R.A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service de Physique Theorique). Nucl. Phys., B; 94: No. 2, 311-336(11 Aug 1975).

Upper and lower bounds on the $\pi^0\pi^0 \to \pi^0\pi^0$ amplitude F(s,t,u) at the symmetry point $s = t = u = 4/3$ are calculated. Use is made of dispersion relations on algebraic manifolds. The solution of the extremum problem given in the first paper, and the Hardy space techniques developed in the second one are also relied upon. The final result is $-73 < F(4/3, 4/3, 4/3) < 7$. These bounds are rigorous consequences of axiomatic analyticity, as well as crossing and unitarity properties. (auth)

**13365** $\pi\pi$ CROSSING SUM RULES AND HIGH-ENERGY AMPLITUDES. MacGregor, B. R. (Durham Univ. (UK)). Nucl. Phys., B; 95: No. 1, 53-76(25 Aug 1975).

Physical region $\pi\pi$ crossing sum rules are systematically derived, several new rules being obtained. In conjunction with finite energy sum rules they are applied to the results of recent $\pi\pi$ phase-shift analyses. It is found not possible to resolve the ambiguities in the phase-shift solutions. The imaginary part of the $\rho$ Regge exchange amplitude is examined and found to have a zero near $t = -0.4$ GeV$^2$. The structure of the imaginary part of the pomeron and of the f exchange amplitude is found; whilst there is insufficient information to carry out this separation uniquely, $\rho$-f exchange degeneracy is found to be broken. The greatest uncertainties come from the poorly known low-energy isospin-two amplitudes. (auth)

**13366** DERIVATION AND IMPLICATIONS OF RIGOROUS ABSOLUTE BOUNDS FOR $\pi\pi$ PARTIAL WAVES UP TO 1 GeV. Bonnier, B. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 95: No. 1, 98-108(25 Aug 1975).

Generalized dispersion relations and axiomatic results are used to derive absolute upper bounds for the $\pi\pi$ partial waves in a complex energy domain containing the physical region up to 1 GeV. As applications, a new lower bound for the $\pi^0\pi^0$ S-wave scattering length is given and some ambiguities in the connection between resonances and second sheet poles are removed. (auth)

**13367** EINSTEIN MODEL FOR ELEMENTARY PARTICLES. Sharma, N. K. (Univ. of Rajasthan, Jaipur, India). Indian J. Phys.; 49: No. 4, 269-286(Apr 1975).

A group theoretical model unifying a space-time group (E) and an internal symmetry group (I) for strongly interacting particles is worked out. The space-time group is the one that pertains to the group of motions of static Einstein cosmological model implying the symmetry of the group $E = O_4 \otimes R$. With the use of Gueret & Vigier prescription, the left coset $R \otimes O_4$ is identified with the internal symmetry group $I = U_1^0 \otimes (SU(2) \otimes SU(2)) \subset SU(4)$. The complete dynamical group (D) is then found to be $D = E \otimes I = (O \otimes R) \otimes U_1^0 \otimes (SU(2) \otimes SU(2) \subset SO(4,2)$. Physically useful representations of the space-time group (E) are worked out by solving the eigenvalue problem of Laplace-Beltmi operator. The internal quantum numbers are prescribed in accordance with the $SU(2) \otimes SU(2)$ model of Nakamura & Sato. A general mass formula is derived, and its use for known baryons and mesons is discussed. (auth)

**13368** MESON EXCHANGE MODEL FOR THE NUCLEON-NUCLEON INTERACTION. Jackson, A. D.; Riska, D. O.; Verwest, B. (State Univ. of New York, Stony Brook (USA). Dept. of Physics). Nucl. Phys., A; 249: No. 3, 397-444(22 Sep 1975).

Nucleon-nucleon interactions obtained from several models for the field theoretic scattering amplitude are studied. The interaction includes contributions from one-pion and one-omega exchange and from two-pion exchange as calculated in a dispersion theory framework. The resulting interaction is regularized by a cut-off factor obtained by the eikonal approximation to multiple vector meson exchange processes. The Blankenbecler-Sugar equation is solved with the interaction and nucleon-nucleon scattering phase parameters are computed. For the best model good agreement with phenomenological phase parameters is achieved for physically reasonable values of the meson-nucleon coupling constants and the spectral functions needed for the evaluation of the two-pion exchange effects. The deuteron wave function is computed as are the deuteron charge and quadrupole form factors. The interaction is shown to have significantly weaker short-range repulsion than commonly found in local phenomenological potentials and in one-boson exchange models. (NL)

## *Strong (Baryon No. = 1)*

**13369** (CEA-N-1791, pp 151-153) LOW ENERGY PION-NUCLEON SCATTERING. Bertin, P.; Bihoreau, B.; Coupat, B.; Duclos, J.; Gerard, A.; Hivernat, A.; Isabelle, D.; Miller, J.; Morgenstern, J.; Mouhot, R. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973-30 September 1974.

The experimental data of $\pi^+$-proton scattering low energy (20 to 96 MeV) were analyzed. Differential cross sections between 60° and 150° were studied and the s- and p-wave phase shifts $\delta_3$, $\delta_{31}$, $\delta_{33}$ were extracted. The analysis of $\pi^-$-proton data is in progress. (FR)

**13370** (COO-3533-61) CURRENT STATUS OF BARYON SPECTROSCOPY. Wall, K. C. (Syracuse Univ., N. Y. (USA). Dept. of Physics). Aug 1975. 28p. (CONF-750729-6; SU-4206-61). Dep. NTIS $4.00.

From new directions in hadron spectroscopy meeting; Argonne, Illinois, USA (7 Jul 1975).

In this review of baryon spectroscopy, the basic ideas of some of the current models and the experimental data for their claims to success are discussed including realistic or constituent quark models, experimental comparison, the experimental and theoretical basis for the assignments, algebraic quark models, and confinement schemes. (JFP)

**13371** (CRN/HE-75-1) FEATURES OF THE $\pi^0\pi^0$ SYSTEM PRODUCED IN 5$\pi$ FINAL STATES BY 3.5 GeV/c $\pi^+$. Riester, J. L.; Arnold, R.; Engel, J. P.; Paty, M. (Strasbourg-1 Univ., 67 (France)). 1975. 11p. Dep. NTIS (US Sales Only) $3.50.

Angular correlations between two pions in the 5-pions final states are studied. A comparison between neutral, like-charged and unlike charged pion-pion systems is done. Evidence is shown for a strong $\pi^0\pi^0$ correlation in the asymmetry parameters as well in the mass distribution. This effect is interpreted in terms of the scattering length approximation. (auth)

**13372** (INIS-mf-1832) CORRELATION BETWEEN PARTICLES IN DIFFRACTION DISSOCIATION. Afonso Filho, J. (Sao Paulo Univ. (Brazil). Instituto de Fisica). 1973. 37p. (In Portuguese). INIS.

Thesis.

In a recent work by Y. Hama, it has been assumed that diffraction dissociation occurs in two stages: (1) coherent excitation of one (or both) of the incident particles and (11) subsequent decay of the excited states, which is independent of how they are formed. In this work we concentrate in studying the decay of the excited states, taking the correlation among the various particles of the final state into account. Since the quoted correlation is actually suggested by the experimental data, our work consists only in inserting the resonances together with the other particles as decay products and studying the possible effects due to this correlation. The calculation is done in the same way as that of the cited reference, where the decay is treated considering only statistical arguments. We calculated the mass spectrum of the $\pi^-\pi^-$ in the reaction $\pi^-A \to (\pi^-\pi^+\pi^-)A$ as an example, as well as that of the 5$\pi$ spectras in the reaction $\pi^-A \to (\pi^-\pi^-\pi^-\pi^+\pi^+)A$, where A is a nucleus. We calculated also the mass spectrum of the $(\pi^-\pi^-\pi^+)$ in $\pi^-p \to (\pi^-\pi^-\pi^+)P$ with correlation, obtaining a distribution analogous to that of the above quoted model. (auth)

**13373** (IPNO/TH-75-10) DISPERSION THEORY OF PARITY NON-CONSERVATION IN PION-NUCLEON SCATTERING AT LOW ENERGIES. Chemtob, M.; Hadjimichael, E. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique; Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire; Fairfield Univ., Conn. (USA)). Apr 1975. 39p. Dep. NTIS (US Sales Only) $4.00.

The possibility for testing the weak parity nonconserving (pnc) interaction in pion-nucleon scattering at low energies. The analysis is started by assuming the existence of a pnc $\pi NN$ coupling which conserves time reversal invariance and has the isospin selection rule $\Delta I = 1$, and the existence of fixed-t dispersion relations obeyed by the pnc invariant amplitudes. By using the non-relativistic expansion, one then derives dispersion relations for the partial wave amplitudes. One calculates parity-odd observables in $\pi^- p \to \pi^- p$ and in $\pi^- p \to \pi^0 n$, e.g., the up-down asymmetry $\alpha$ in the total cross section for a polarized target and the longitudinal polarization P of the recoil nucleon. In the conventional Cabibbo model for the weak interaction, P and $\alpha$ are found to be of order $10^{-7}$ to $10^{-6}$. The t-channel pnc $\rho$-exchange process which has the isospin selection rule $\Delta I = 0,2$ was also examined and found to contribute dominantly to P in the charge exchange channel $\pi^- p \to \pi^0 n$. (auth)

**13374** (JINR-P1, 2-8529, pp 238-262) $\pi N$ SCATTERING AT HIGH ENERGY IN THE QUASIPOTENTIAL APPROACH. Kazarinov, Yu. M.; Garsevanishvili, V. R. (Joint Inst. for Nuclear Research, Dubna, USSR). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The results of the use of the quasipotential approach for a description of experimental data on $\pi N$ scattering at high energies ($P_L \geq 10$ GeV/c) in the region of small momentum transfer are reported. It is noted that in contrast to the Regge pole model the quasipotential approach gives a significantly better description of backward $\pi N$ scattering. (JSR)

**13375** (JINR-P1, 2-8529, pp 457-485) SOME REGULARITIES IN PROCESSES OF MULTIPLE PRODUCTION OF PARTICLES. Sisakyan, A. N. (Joint Inst. for Nuclear Research, Dubna, USSR). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

Two examples of the construction of models of the multiple production of particles are reported. Results obtained during the examination of multiple production within the framework of the quantum field theory model are given. The direct path approximation was discussed which realizes the concept of the leading particle and leads to the generalized Poisson multiplicity distribution and to the self-modeling behavior of the cross section. Attempts to construct a specific phenomenological scheme for a description of experimental data by using some results of the direct path approximation are reported. The models are compared with tests made on the 2-m chamber during its irradiation with negative 40-GeV $\pi$ mesons. (JSR)

**13376** (JINR-P1, 2-8529, pp 486-491) INVARIANT DESCRIPTION OF THE SPACE STRUCTURE OF PARTICLES. Skachkov, N. B. (Joint Inst. for Nuclear Research, Dubna, USSR). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The presence in particles structures, i. e., deviations from pointness, is described by their form factors. An invariant expression for the form factors of nucleons is derived. (JSR)

**13377** UNCERTAINTIES IN RESONANCE MASSES AND WIDTHS DUE TO PHASE SHIFT AMBIGUITIES. Atkinson, D. (Inst. for Theoretical Physics, Groningen, Netherlands). pp 171-182 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

Continuum ambiguities in phase shift analysis are discussed for $\pi^+ p$ and $K^+ p$ scattering. Differential and total cross sections and the polarization are calculated. It is concluded that the inherent continuum ambiguity is so large that none of the bumps need be taken seriously. In particular, the $K^+ p$ data do not support the existence of exotic resonances. (JFP)

**13378** TEST OF MODELS AND POLARIZATION EFFECTS: THE QUARK MODEL. Doncel, M. G. (Univ., Barcelona); Michel, L.; Minnaert, P. pp 383-412 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

A suggested strategy for tests of models is outlined. This is illustrated by an example, that of the quark model and a family of reactions: pseudoscalar meson reactions on an unpolarized nucleon target. The predictive value of a model for a given experiment and the agreement of the polarization measurement with the model are also discussed. (JFP)

**13379** CALCULATION OF THE PROTON MASS IN A LATTICE MODEL FOR THE ETHER. Aspden, H. (Hursley Labs., Winchester, Eng.); Eagles, D. M. Nuovo Cim.; 30A: No. 2, 235-238(21 Nov 1975).

A lattice model for the aether is shown to give indications of a fundamental charged particle of mass M such that $M/m_e = \frac{3}{4}(108)^{\frac{1}{3}}\pi^{\frac{2}{3}}(1843)^{-\frac{1}{3}}[(\frac{3}{2})^{\frac{1}{3}} - 1]^{-1} = 1836.15232$, a value very close to the observed proton-electron mass ratio of 1836.15152(70). (auth)

**13380** EFFICIENCY OF SEPARATION OF EVENTS IN THE REACTION CHANNELS IN $\pi^- p$ INTERACTION WITH 11-GeV/sec PULSES. Vinitskii, A. Kh.; Izbasarov, M. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 75-78(1975). (In Russian)

Using the FORS program, 6-ray pion-nucleon interactions with an energy of 11 GeV/sec were modeled with calculation of the angular distribution of the nucleons and experimental errors in the angles and momenta of secondary particles. Selected criteria were compared with experimental data, and the efficiency of separating events along the reaction channels was determined. (tr-auth)

**13381** PHASE SHIFT ANALYSIS: A REVIEW OF THE UNCERTAINTIES AND AMBIGUITIES. Baracca, A. (Univ., Florence). Riv. Nuovo Cim.; 5: No. 2, 312-338(1975).

The method of partial-wave analysis, which is considered to be the most refined method for the study of resonances, is examined from the unusual viewpoint of a review of the uncertainties and the troubles involved in this procedure. (JFP)

**13382** $K_L^0 p$ INTERACTIONS AS A PROBE FOR $S = \pm 1$ BARYON STATES. Alexander, G.; Bar-Nir, I. (CERN, Geneva). pp 576-603 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

Some aspects of strange baryon states are discussed in the light of two recent $K_L^0 p$ reaction experiments. The discussion is confined to the low energy region where the s-channel resonances play a dominant role. (JFP)

**13383** DUALITY IN REGGEON-PARTICLE SCATTERING. Estabrooks, P. (Durham Univ. (UK)). pp 153-160 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Recontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Results of duality tests as applied to Reggeon-particle scattering in $\pi^- p \to \pi^- \pi^+ n$ are presented. The implications of these and other quasi-two-body results for high energy multiparticle production mechanisms are discussed. (FR)

**13384** POLARIZATION AND SPIN ROTATION MEASUREMENTS IN $\pi^- p$ AND $K^- p$ ELASTIC SCATTERING AT 40 GeV/c. Ducros, Y. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique des Particules Elementaires). pp 137-146 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Recontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The polarization parameter $P_0$ and the spin rotation parameter R has been measured at Serpukhov in $\pi^- p$ and $K^- p$ elastic scattering at 40 GeV/c. These measurements show a decreasing of $P_0$ compatible with a Regge model. The helicity flip amplitude in the Pomeron exchange is of the nonflip amplitude. (FR)

**13385** THE $\rho NN$ VERTEX IN VECTOR-DOMINANCE MODELS. Hoehler, G.; Pietarinen, E. (Karlsruhe Univ. (TH) (F.R. Germany). Inst. fuer Theoretische Kernphysik). Nucl. Phys., B; 95: No. 2, 210-230(1 Sep 1975).

A new πN amplitude analysis and experimental data for the pion form factor have been used in order to determine the I = J = 1 ππNN̄ partial waves and properties of the ρNN vertices. The results are compared with earlier determinations of ρNN coupling constants from πN and NN scattering and from nucleon form factor data. (auth)

**13386** ANALYSIS OF THE πN INVARIANT AMPLITUDES IN TERMS OF ALGEBRAIC FUNCTIONS AND A NEW DETERMINATION OF THE πN LOW-ENERGY PARAMETERS. Langbein, W. (Fachbereich Physik der Universitaet Kaiserslautern, Federal Republic of Germany). Nucl. Phys., B; 94: No. 3, 519-547(18 Aug 1975).

The energy dependence of the πN invariant amplitudes has been analyzed in terms of algebraic functions which automatically fulfill fixed-t dispersion relations. The amplitudes were taken from several phase shift solutions. The analysis was repeated for nine t-values between $0 \geq t \geq -0.3$ GeV$^2$. By evaluating analytic amplitudes at threshold and at ν = 0 the S,P,D scattering lengths and the current algebra σ term are recalculated. The trajectories of the zeros and poles in the complex energy plane are also discussed. (auth)

**13387** s- AND t-CHANNEL HELICITY CONSERVATION IN THE DIFFRACTION PART OF THE REACTION $\pi^+p \rightarrow \pi(N\pi)$ AT 16 GeV/c. Graessler, H.; Kirk, H.; Otter, G. (Technische Hochschule Aachen (F.R. Germany). 3. Physikalisches Inst.); Boettcher, H.; Walter, M. (Akademie der Wissenschaften der DDR, Berlin-Zeuthen. Inst. fuer Hochenergiephysik); Boeckmann, K.; Hartmann, R.; Plothow, H.; Zobernig, G. (Bonn Univ. (F.R. Germany). Physikalisches Inst.); Cocconi, V. T. Nucl. Phys., B; 95: No. 1, -11(25 Aug 1975).

By means of an isospin analysis of the reactions $\pi^+p \rightarrow \pi(N\pi)$ at 16 GeV/c the decay angular distributions of the Nπ system with isospin I = ½ produced by isospin zero exchange have been determined. Helicity conservation is not observed in the t-channel for the Nπ mass region below 1.6 GeV, where diffraction dissociation of the proton is supposed to dominate. There are indications for approximate t-channel helicity conservation for N*(1690) production. In the helicity frame, the experimental data are not in agreement with s-channel helicity conservation over the whole Nπ mass range investigated. Thus the diffractive process $N \rightarrow N\pi$ differs both from the process $N \rightarrow N\pi\pi$ (or $\pi \rightarrow \pi\pi\pi$ and $K \rightarrow K\pi\pi$) which approximately conserves t-channel helicity and from the elastic scattering $N \rightarrow N$ which conserves helicity in the s-channel. (auth)

**13388** GEOMETRICAL SCALING IN ΦN SCATTERING. Barger, V. (Wisconsin Univ., Madison (USA). Dept. of Physics); Phillips, R. J. N. (Science Research Council, Chilton (UK). Rutherford Lab.). Phys. Lett., B; 58: No. 2, 197-200(1 Sep 1975).

Geometrical scaling has been proposed for the Pomeron term in elastic scattering. ΦN scattering, that is expected to be Pomeron-dominated even at quite low energies, is investigated, and it is found that present data are quite consistent with geometrical scaling down to 4 GeV and possibly even to 2 GeV. (NL)

**13389** GEOMETRICAL SCALING: A PROPERTY OF THE INELASTIC OVERLAP FUNCTION. Grein, W. (Karlsruhe Univ. (TH) (F. R. Germany). Inst. fuer Theoretische Kernphysik); Kroll, P. (Wuppertal Univ. (Gesamthochschule) (F. R. Germany)). Phys. Lett., B; 58: No. 1, 79-82(18 Aug 1975).

Geometrical scaling (GS) of the inelastic overlap function and GS of the imaginary part of the elastic nonflip amplitude are discussed and their consequences are compared. Since the corresponding real part does not scale both types of GS are not equivalent. It is shown that the energy dependences of the slope parameters and of the total cross sections for pp, p̄p, πp and Kp scattering are compatible with GS of the overlap functions. (NL)

**13390** PARTIAL-WAVE ANALYSIS OF THE $(\bar{K}^0\pi^-\pi^0)$ SYSTEM PRODUCED IN THE Q-MASS REGION IN $K^-p \rightarrow (\bar{K}^0\pi^-\pi^0)p$ AT 10 AND 16 GeV/c. Otter, G.; Rudolph, G.; Seyfert, H. H.; Wieczorek, H. (Technische Hochschule Aachen (F. R. Germany). 3. Physikalisches Inst.); Klugow, J.; Nowak, H. (Akademie der Wissenschaften der DDR, Berlin); Cocconi, V. T.; Counihan, M. J.; Hansen, J. D.; Morrison, D. R. O. Nucl. Phys., B; 96: No. 1, 29-44(15 Sep 1975).

A partial-wave analysis has been performed of the diffractively produced low-mass $(\bar{K}^0\pi^-\pi^0)$ system in the reaction $K^-p \rightarrow (\bar{K}^0\pi^-\pi^0)p$ at 10 and 16 GeV/c. Thus information complementary to that derived from the $K^-p \rightarrow (K^-\pi^+\pi^-)p$ channel is obtained. The presence of the Kρ decay mode, besides the dominant K*(890)π mode, for the state $J^P = 1^+$ is confirmed. It is also confirmed that for this $1^+$ state the assumption of factorization of the amplitude into "production" and "decay" does not hold: the two decay modes K*π and Kρ have different polarization properties (helicity is approximately conserved in the t-channel for the first, in the s-channel for the second). The assumption that the $(\bar{K}^0\pi^-\pi^0$ system has isospin I = ½ has been tested and found to hold. From the cross sections for the various $J^P$ states, assuming I = ½, the cross sections for the $(K^-\pi^+\pi^-)$ system are predicted and compared with the experimental ones. In general, agreement is found. (NL)

**13391** PION–NUCLEON OFF-SHELL T-MATRIX IN PION NUCLEUS INTERACTIONS. Gibbs, W. R. (Los Alamos Scientific Lab., NM). pp 205-225 of Investigation of Nuclear Structure by Scattering Processes at High Energies. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From international school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974). See CONF-7409109-.

The pion-nucleon half-off-shell t-matrix describes the pion-nucleon wave function at short distances. If one is to attempt to use pions to probe the short range nucleon–nucleon correlations in nuclei it is certainly necessary to understand the short range pion-nucleon interaction. Since the strongest multiple scattering occurs when the distance between scatterers is small it is possible that all cross sections are affected. The size of this effect and (to some extent) the degree of agreement with experiment is discussed. 15 figures. (auth)

**13392** INVESTIGATIONS IN BOUND-STATE MODELS OF THE NUCLEON. Pesic, P. D. Stanford, CA; Stanford Univ. (1975). 96p. University Microfilms Order No. 75-25,586.

Thesis (Ph. D.).

Models of the nucleon as a bound state of constituent partons held together by a gluon field are considered. The Bethe–Salpeter equation is used as a "theoretical laboratory" for investigating how important relativistic effects are in such bound states and how the bound state depends upon the parameters of the constituents and their interactions. One obtains numerical solutions to the Bethe–Salpeter equation in various cases as well as to approximate equations like the Blankenbecler–Sugar equation, in which retardation is effectively neglected. Earlier work of others is extended by considering the heavy gluon case and by considering besides the case with spinless partons and gluons the case with one spin one-half and one spin zero parton (Drell–Lee case). It was found that the parton-gluon coupling constants depends linearly upon the gluon mass if that mass is large compared to the parton mass, and quadratically if that mass is small. Strikingly, the Blankenbecler–Sugar approximation is quite good, especially if the gluons are heavy and the binding strong. Yet the average momentum of the constituents is relativistic. Also the bound state wave function exhibits a certain insensitivity to the parameters of the interaction when the gluons are heavy or when the binding is strong. (Diss. Abstr. Int., B)

**13393** ELASTIC SCATTERING OF $K^+$-MESONS FROM A POLARIZED PROTON TARGET FOR SMALL (t) AND SMALL (u). Patton, R. S. New Haven; Yale Univ. (1975). 171p. University Microfilms Order No. 75-24,585.

Thesis (Ph. D.).

Measurements of differential cross sections and polarizations in $K^+p$ elastic scattering from a polarized proton target at five momentum points: 1.7, 2.1, 2.4, 2.7, and 3.0 GeV/c are reported. These measurements were made both at small (t) (forward scattering) and small (u) (backward scattering). The detection apparatus was a combination of proportional wire chambers and scintillation counters. An aperture free geometrical acceptance was achieved by using cylindrical proportional chambers as part of the scattered particle detector. The principal motivation for the experiment was to investigate an anomaly in the slope and magnitude of the backward cross sections. The data of this experiment modified but still confirmed the anomaly in the backward cross sections; the polarizations in the region of the anomaly were small but systematically negative in contradiction with pure exchange degenerate Regge pole models. The forward data are statistically precise and should represent strong constraints on phase shift analysis and other phenomenological models. (Diss. Abstr. Int., B)

**13394** AMPLITUDE ANALYSIS FOR THE REACTION pi$^-$p yields pi$^+$pi$^-$pi$^0$DELTA$^{++}$ AT 7 GeV/c. Wagner, F.; Tabak, M.; Chew, D. M. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Phys. Lett., B; 58: No. 2, 201-205(1 Sep 1975).

An amplitude analysis for the reaction pi$^+$p yields pi$^+$pi$^-$pi$^0$ DELTA$^{++}$ at 7 GeV/c has been performed using the isobar model for the 3 pi system. The 3 pi-mass covers the range from 0.82 to 1.90 GeV. Strong $A_2$ production is observed. The spin parity of the omega*(1700) is determined to be $3^-$. No significant $A_1$ production can be seen. (NL)

## *Strong (Baryon No. ≥ 2)*

*Refer also to abstracts 13160 and 13166.*

**13395** (IFVE-SPK-74-94) SEMIEMPIRICAL FORMULA FOR HADRONS SPECTRA IN pp-INTERACTIONS. Korotkov, V. A.; Makeev, V. V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Serpukhov. Inst. Fiziki Vysokikh Ehnergij). 1974. 19p. (In Russian). INIS.

17 refs.; 20 figs.; 1 table.

Based on the Weiland and Bowen two-temperature model, a semiempirical formula was derived for hadron spectra in p,p interactions. The formula satisfies the scaling hypothesis. Formula parameters were selected for 11 secondary particles ($\pi^{\pm}$, $K^{\pm}$, $K^0$, p, $\bar{p}$, $\Lambda$, $\Sigma^{\pm}$, $\Xi^-$). A satisfactory description was obtained in a wide range of proton energies for $|x|$ of 0.1 or greater. (tr-auth)

**13396** (PUC-TN-16/74) BINDING CORRECTIONS AND FINAL STATE INTERACTION EFFECTS IN LOW ENERGY DEUTERON BREAK-UP. Ferreira, E.; Rosa, L. P.; Thome, Z. D. (Pontificia Universidade Catolica do Rio de Janeiro (Brazil). Instituto de Fisica). Nov 1974. 15p. INIS.

The effects of the neutron-proton interaction as corrections to the impulse approximation calculation of differential cross section for deuteron break-up scattering are studied. Low energy processes and application of the results to pion deuteron scattering at energy below the P33 resonance are mainly analyzed. (auth)

**13397** FROM PARTICLE-NUCLEUS TO PARTICLE-PARTICLE INTERACTION. Pajares, C. (Univ., Barcelona). pp 157-169 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

Some properties of particle-particle models are tested as far as these properties do not involve the constitutents of the target, by applying two-particle-particle interaction models to the analysis of particle-nucleus data. First the pd data are analyzed in the framework of the two-component model. It is shown that the ratio between the diffractive and nondiffractive cross section is smaller than in particle-particle scattering. In this model this suppression gives rise to a quantitatively different multiparticle production behavior. Secondly, Reggeon calculus is applied to high energy scattering on nuclei. It is seen that the intranuclear cascade is forbidden, with the result that the multiplicity does not depend strongly on the atomic number. (JFP)

**13398** DIFFRACTIVE SCATTERING AND MODELS FOR A RISING CROSS SECTION. Capella, A. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique Theorique et Particules Elementaires). pp 299-316 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The proton inclusive spectrum in the diffractive region is described by a PPP term, obtained from resonance production data at conventional accelerator energies via Finite Mass Sum Rules, with no free parameter. This term gives a contribution to $\sigma_{inel}^{pp}$ which increases with s in a way consistent with experiment. We also show that the Gribov's Reggeon Calculus does not seem to be a good candidate to describe physics at ISR energies. (FR)

**13399** DIFFRACTION SCATTERING AND EXCITATIONS IN A GLUON-PHOTON ANALOGY MODEL. Dar, A. (Technion-Israel Inst. of Tech., Haifa. Dept. of Physics); Moriarty, K. J. (Royal Holloway Coll., Englefield Green (UK). Dept. of Mathematics); Tran Thanh Van, J. (Paris-11 Univ., 91- Orsay (France). Lab. de Physique Theorique et Hautes Energies). pp 249-260 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires [nd].

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Using the gluon-photon analogy, a model for diffraction scattering and diffraction excitation in hadron-hadron collisions is obtained. This model, which has only one free constant, the slope of the gluon trajectory, successfully reproduces the available data on elastic scattering and diffractive excitations in high energy pp collisions. (FR)

**13400** ANALYSIS OF MULTIPLE-PRODUCTION PHENOMENA ON THE BASIS OF NIU'S TWO-FIREBALL MODEL. Fuchi, H.; Niu, K. (Nagoya Univ., Japan). Lett. Nuovo Cim.; 14: No. 14, 511-516(6 Dec 1975).

From the results of an investigation of multiple-production phenomena in the accelerator energy region are reported from the standpoint of the fireball model, it is found that the mean mass of the fireball derived from the energy-independent distribution of $\Delta^*$ satisfies the energy dependence of the mean multiplicity as well as the energy independence of the mean transverse momentum of mesons. Proton-proton interactions are considered. (JFP)

**13401** MODEL FOR MEAN MULTIPLICITY IN HADRON-NUCLEUS COLLISIONS. Takagi, F. (Tohoku Univ., Sendai). Lett. Nuovo Cim.; 14: No. 15, 559-564(13 Dec 1975).

A simple model is proposed for mean multiplicity of hadron reactions based on the nucleus behavior of a "big hadron". A given multiplicity ratio is mainly considered and compared with experimental data, and mean effective mass numbers are found for proton and negative pion reactions at high energies. (JFP)

**13402** TEST OF 1 GeV NN MATRIX ON ELASTIC-SCATTERING GLAUBER-MODEL CALCULATION. Brissaud, I.; Bimbot, L.; Le Bornec, Y.; Tatischeff, B.; Willis, N. (Inst. of Nuclear Physics, Orsay, France). Lett. Nuovo Cim.; 14: No. 15, 565-568(13 Dec 1975).

The isospin-independent terms of the NN scattering matrix are shown, and their general form is given. It is found that these terms are not proportional. There is a decrease for those small momentum transfers which are most important in multiple-scattering events, where the momentum transfer is composed of n collisions of average momentum transfer. (JFP)

**13403** NUCLEON-ANTINUCLEON PRODUCTION AS THE CAUSE OF $\sigma_{pp}^{tot}$ RISE AT ISR. Tan, C. I. (Brown Univ., Providence, R. I. (USA)). pp 451-472 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

The suggestion that the rise of $\sigma_{pp}^{tot}$ at ISR is due to the production of nucleon-antinucleon pairs is reviewed. Various techniques for estimating the $N\bar{N}$ cross section are discussed. The increase in $N\bar{N}$ production is not cancelled by a corresponding decrease in the rest of the nondiffractive cross section. Phenomenological consequences of the conjecture are provided. The phenomenon of bare Pomeron renormalization is clarified. (FR)

**13404** INCLUSIVE REACTION pp = pX AT THE CERN ISR. Strolin, P.; Albrow, M. G. (European Organization for Nuclear Research, Geneva (Switzerland)). pp 237-248 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Experiments at the CERN ISR have given evidence for proton single-dissociation processes where the missing mass of the system X, measured on the proton which is observed in the reaction $p + p \rightarrow p + X$, presents a distribution extending up to large values, in the 10 GeV range. These processes globally account for approximately 15% of the inelastic p-p cross section. Evidence for such a distinct class of inelastic phenomena is also provided by long-range rapidity correlations and clustering. The nature of these processes appears to be predominantly diffractive. The physics which emerges from ISR observations is discussed, together with a presentation of present and planned lines of experimental investigation at the ISR. (FR)

**13405** DO PRESENT EXPERIMENTAL DATA DETERMINE THE TRIPLE POMERON COUPLING AT t = 0. Siotis, I. (Imperial Coll. of Science and Technology, London (UK)). pp 269-274 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

It is shown that, contrary to common belief, all present experimental data on $pp \rightarrow pX$ are consistent with a triple Pomeron coupling which vanishes as t tends to zero. (FR)

**13406** S-CHANNEL MODELS FOR THE POMERON. Peccei, R. D. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). pp 317-338 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Meribel-les-Allues, France (3 Mar 1974).

Various difficulties of recent s-channel models for the Pomeron are discussed. Some of these difficulties can be overcome where one introduces a dynamical mechanism for generating the triple Pomeron zero and/or includes absorptive effects. (FR)

**13407** TRIPLE REGGE ANALYSIS OF $pp \rightarrow pX$. Roberts, R. G. (Science Research Council, Chilton (UK). Rutherford High Energy Lab.). pp 261-268 of Interactions Hadroniques a Hautes Energies. Vol. I. Tran Thanh Van, J. (ed.). Orsay, France; Universite de Paris-11. Laboratoire de Physique Theorique et Particules Elementaires ([nd]).

From 9th Rencontre de Moriond; Merible-les-Allues, France (3 Mar 1974).

All existing data on $pp \rightarrow pX$ have been analyzed and the PPP and PPM terms obtained. The PPP term is dominant and, taking into account double diffractive dissociation, gives rise to an increase in the total cross-section of 3.3 mb from 200 to 2000 GeV/c. A prediction is given for the size of the double-Pomeron cross section at 300 GeV/c. (FR)

**13408** LEADING PARTICLE SPECTRUM AND THE MULTIPLICITY DISTRIBUTION IN HIGH ENERGY COLLISIONS. Benecke, J. (Muenchen Univ. (F. R. Germany). Sektion Physik); Bialas, A. (Paris-11 Univ., 91-Orsay (France). Lab. de Physique Theorique et Particules Elementaires); de Groot, E. H. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 57: No. 5, 447-451(4 Aug 1975).

A relation between the leading particle spectrum and the Koba-Nielsen-Olesen scaling function is derived. It describes the peak-plateau structure of the leading proton spectrum observed at high energies. Furthermore the associated cluster multiplicity is discussed. (auth)

**13409** AN ESTIMATE OF THE EFFECT OF NUCLEAR FERMI MOTION ON LARGE TRANSVERSE MOMENTUM INCLUSIVE SPECTRA FROM HIGH-ENERGY PROTON-NUCLEUS COLLISIONS. Fredriksson, S. (Kungliga Tekniska Hoegskolan, Stockholm (Sweden). Institutionen foer Teoretisk Fysik). Nucl. Phys., B; 94: No. 2, 337-343(11 Aug 1975).

The effect of nuclear Fermi motion on large $p_T$ inclusive hadron spectra and particle ratios from high-energy proton-nucleus collisions is estimated within the scope of the parton model for proton-nucleon collisions and the box model for the nucleus. Considerable effects are found in some cases. (auth)

**13410** ANALYSIS OF PROTON-DEUTERON DATA IN THE TWO-COMPONENT MODEL. Pajares, C. (Barcelona Univ. (Spain). Departamento de Fisica Teorica). Nucl. Phys., B; 94: No. 2, 197-204(11 Aug 1975).

Recent data on pd collisions are analyzed. The ratio between the diffractive and inelastic cross section is found to be significantly smaller than in pp scattering. This fact indicates that the behavior of pd collisions will be close to the multiperipheral predictions. Several consequences of the expected values of multiplicities, correlations and average number of particles per cluster are analyzed in the framework of the two-component model. (auth)

**13411** INVESTIGATION OF DIFFRACTION DISSOCIATION IN SINGLE-PION PRODUCTION REACTIONS IN NUCLEON-NUCLEON COLLISIONS AT 12 GeV/c. Boeckmann, K.; Geich-Gimbel, C.; Heilmann, H. G.; Idschok, U.; Propach, E. (Bonn Univ. (F.R. Germany). Physikalisches Inst.); Blobel, V.; Fesefeldt, H.: Neumann, H.; Schulze-Hagenest, D. (Deutsches Elektronen-Synchrotron (DESY), Hamburg (F. R. Germany)); Franz, H. Nucl. Phys., B; 96: No. 1, 45-53(15 Sep 1975).

An isospin analysis of the reaction $N_1N_2 \rightarrow N_3(N_4\pi)$ at 12 GeV/c has been performed. Cross sections and effective mass distributions for the squared isospin amplitudes and the interference terms are presented. Factorization properties of the diffraction dissociation are investigated as a function of the $(N\pi)$ mass. (NL)

**13412** AMPLITUDE STRUCTURE IN PROTON-PROTON ELASTIC SCATTERING. Gotsman, E. (Tel Aviv Univ. (Israel). Dept. of Physics and Astronomy); Maor, U. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Theorique). Nucl. Phys., B; 96: No. 1, 167-185(15 Sep 1975).

A comprehensive study of forward elastic proton-proton scattering over a wide energy range $10 \leq s \leq 3000$ GeV$^2$, is carried out in terms of s-channel helicity amplitudes. A hybrid model is constructed in which the pomeron exchange is represented by the sum of Bessel functions parameterizing the proton core and periphery: this is augmented by the exchange of Regge trajectories which contribute to the helicity single and double flip amplitudes, and have a dynamical dependence determined by a cylindrical Bessel function of order one. The model yields a reasonable fit simultaneously to the measured total and differential cross sections, the ratio of $\mathrm{Re}phi_1(s,0)/\mathrm{Im}phi_1(s,0)$ the polarization and correlation tensor in the energy range mentioned above, and for momentum transfer squared values, $-t<3$GeV$^2$. (NL)

# Particle Invariance Principles and Symmetries

**13413** DYNAMICAL SYMMETRY BREAKING. Jackiw, R. (Massachusetts Inst. of Tech., Cambridge). pp 224-251 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

Lectures are given describing three different examples of the Schwinger mechanism leading to a pole in $\pi(q^2)$. The Schwinger original example of two-dimensional massless spinor electrodynamics, the Higgs mechanism, and one based on a bound state mechanism for symmetry breaking are the examples discussed. (JFP)

**13414** FROM CONSTITUENT TO CURRENT QUARKS BREAKING SU(6)W. Buccella, F. (Univ., Rome). pp 368-376 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

It is established whether the unitary operator of previous work takes into account correctly $SU(6)_W$ breaking for constituent and current quarks. This problem is studied with the Weinberg equations. It is found reasonable to think that the transformation of the previous work not only has the group suggested by a previous interpretation, but also is needed to take into account the breaking of $SU(6)_W$. (JFP)

**13415** GAUGE SYMMETRY, SPACE-TIME, AND RELATIVISTIC QUANTUM DYNAMICS. Roman, P. (Univ. of Boston). pp 85-101 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).

From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.

A review is given of recent work on gauge symmetry, space-time, and relativistic quantum dynamics, exploring the importance of both the overall structure of space-time as well as the principle of locality, inasmuch as they seem to relate to general quantum dynamics. (JFP)

**13416** SOME RECENT EXPERIMENTS CONCERNING CP VIOLATION, AND A BRIEF REVIEW OF THE PRESENT STATUS OF CP-VIOLATING PHENOMENOLOGY. Steinberger, J. (CERN, Geneva). pp 422-447 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The results of the CERN Heidelberg experiment concerning the measured parameters reflecting CP violation, the $K_S - K_L$ interference in the $2\pi$ decay, leptonic decay asymmetries, $\Delta m$ measurement using the two-regenerator method, and a phenomenological analysis of these and other data are presented. (JFP)

**13417** SPONTANEOUSLY BROKEN SYMMETRY AND THE CUSP CATASTROPHE. Araki, J.; Yano, T.; Ueda, M.; Noda, M. T. (Ehime Univ., Matsuyama, Japan). Proc. R. Soc. (London), Ser. A; 345: No. 1642, 413-416(30 Sep 1975).

Spontaneously broken symmetry is discussed from the viewpoint of Thom's catastrophe theory (Stabilite structurelle et morphogenese. Massachusetts. Benjamin, Inc. (1972)). It is just the Maxwell convention in cusp catastrophe and is a special case of the usual symmetry breaking. The relation between usual symmetry breaking and "bag theory" is suggested briefly. (auth)

**13418** GENERATING FUNCTIONS FOR THE COUPLING-RECOUPLING COEFFICIENTS. Labarthe, J. J. (CNRS, Orsay, France). J. Phys., A (London); 8: No. 10, 1543-1561(Oct 1975).

A general formula for the generating function of an arbitrary coupling-recoupling coefficient of SU(2) is derived via the Bargmann formalism (Rev. Mod. Phys.; 34: 829 (1962)) and graphical calculations. The result is expressed in terms of sums over the two finite sets only of subgraphs of the Jucys graph of the coefficient. A new explicit expression for the coefficient is obtained. (auth)

## General

*Refer also to abstract 13251.*

**13419** FIFTY YEARS OF QUANTUM FIELD THEORY. Low, F. E. (Massachusetts Inst. of Tech., Cambridge). pp 934-938 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The discussion of the development of quantum field theory covers a period of about five decades including quantum electrodynamics, the atomic nucleus, hadronic interactions, dispersion theory, and symmetries and symmetry breaking. (JFP)

**13420** WHAT ARE PROTONS MADE OF. The Quark Model. Ravndal, F. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen). Fra Fys. Verden; 37: No. 2, 25-28(1975).

The quark model is presented and discussed with reference to SU(3) triplets, octets and decuplets. From consideration of the magnetic moments of protons and neutrons it is deduced that the mass of a quark is about 300 MeV. The quark model has led to the discovery of three octets, one decuplet and two singlets. All other hadrons are also octets, singlets and decuplets, but with spin and parity differing from the sum of the quark spin. Regge tracks are also discussed. (JIW)

**13421** SPONTANEOUS SYMMETRY BREAKING FOR CHIRAL SCALAR SUPERFIELDS. O'Raifeartaigh, L. (Dublin Inst. for Advanced Studies (Ireland)). Nucl. Phys., B; 96: No. 2, 331-352(22 Sep 1975).

The spontaneous breakdown of supersymmetry and internal symmetry is studied for the interaction of N chiral scalar superfields. A lemma is established which shows that the spontaneous breakdown of supersymmetry is a very rare occurrence, but that it can happen (in at least the tree approximation) is shown by the construction of a model. This model contains three superfields (N = 3) and preserves parity. In contrast to supersymmetry itself, a spontaneous breakdown of internal symmetry triggered by the supersymmetry is found to be a frequent occurrence, and a general formalism for it is set up. A mass-formula is derived and examples given. (NL)

**13422** EXPLICIT SPONTANEOUS BREAKDOWN IN A DUAL MODEL. II. n-Point Functions. Bardakci, K. (Ecole Normale Superieure, 75 - Paris (France)); Halpern, M. B. (California Univ., Berkeley (USA). Dept. of Physics). Nucl. Phys., B; 96: No. 2, 285-306(22 Sep 1975).

The program of spurion summation of dual models is continued. Starting from the propagator found in the first paper of this name, sufficient technique is developed to construct the final n-point functions. (NL)

**13423** BARYON RESONANCES AND SU(4). Vergara-Caffarelli, R. (Pisa Univ. (Italy). Istituto di Fisica). Phys. Lett., B; 58: No. 1, 100-104(18 Aug 1975).

It is shown that the assignment of the baryonic resonances to the adjoint representation of the SU(3) × U(1)$F_{15}$ subgroup of SU(4) gives rise to nonets which have a natural extension to decuplets with the inclusion of an SU(4) singlet. For each of them the Λ-Λ'-Λ'' mixing and two of the masses can be computed. The multiplets $\frac{1}{2}^+$, $\frac{1}{2}^-$, $\frac{3}{2}^-$, $\frac{5}{2}^+$, $\frac{7}{2}^-$ are studied in this scheme and an excellent agreement is obtained with the experimental data. (NL)

## *Applications (Electromagnetic and Weak)*

**13424** TESTING THE CPT IN THE K-OPTICS. Marx, G. (Eotvos Lorand Tudomanyegyetem, Budapest (Hungary). Atomfizikai Tanszek). Acta Phys. Slovaca; 24: No. 3, 167-181(1974).

From triangle meeting on weak interactions; Smolenice, Czechoslovakia (4 Jun 1973).

The experiments conducted so far have indicated that neutral K decays violate the CP and T symmetries, but conserve the CPT symmetry, which is strictly related to local causality. The accuracy of this indication is discussed. (auth)

**13425** SU(3) BREAKING AND CABIBBO ANGLE. Lanik, J. (Slovenska Akademia Vied, Bratislava (Czechoslovakia). Fyzikalny Ustav). Acta Phys. Slovaca; 24: No. 3, 182-188(1974).

From triangle meeting on weak interactions; Smolenice, Czechoslovakia (4 Jun 1973).

A theory of the Cabibbo angle $\nu$ is suggested within the SU(3) symmetry breaking. In this theory the parameter $\nu$ is fixed and computed by linking together the Cabibbo rotation and the full strong interaction SU(3) breaking, and by using a subsidiary condition of the value of $\nu$ being zero in the world with zero pion masses. The computed value $\nu = 0.27 \pm 0.05$ is in a good agreement with the experiment. (auth)

**13426** MASSIVE GOLDSTONE BOSONS IN THE MODEL OF MILLIWEAK CP-BREAKING. Grib, A. A.; Mostepanenko, V. M. Vestn. Leningr. Univ., Fiz., Khim.; No. 1, 14-19(Feb 1975). (In Russian).

The scheme of CP-symmetry breaking in the weak interactions is constructed. It is shown that if the hypothesis of strangeness conservation breaking in the strong interactions is accepted then the CP-noninvariance of the weak interactions follows from the CPT-invariance requirement. The CP-breaking interaction is milliweak. The properties of massive Goldstone bosons which distinguish the given scheme from the phenomenological model of milliweak CP-breaking are determined. The physical sense of these bosons is discussed. (auth)

**13427** INTENSITY-DEPENDENT MASS SHIFT AND SYMMETRY BREAKING. Kibble, T. W. B. (Imperial Coll. of Science and Technology, London (UK)); Salam, A.; Strathdee, J. (International Centre for Theoretical Physics, Trieste (Italy)). Nucl. Phys., B; 96: No. 2, 255-263(22 Sep 1975).

The effects of the intensity-dependent mass shift predicted for electrons in an electromagnetic plane wave on bound states are analyzed. It is shown that the null result of the experiment of Mowat et al. on the $^{133}$Cs ground-state hyperfine splitting was to be expected, although their hypothetical explanation of it is incorrect. The recent suggestion that an intense laser beam might effect the restoration of a spontaneously broken symmetry is examined in more detail, and it is demonstrated that although a pure plane will not suffice, a superposition of plane waves, for example a standing wave, would do so. At present, however, the effect is unobservably small. (NL)

**13428** NONCONSERVATION OF MUON NUMBER AND CP NONINVARIANCE. Barshay, S. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires). Phys. Lett., B; 58: No. 1, 86-88(18 Aug 1975).

Based upon a possible quark-lepton symmetry, it is suggested that the conservation of muon number may be violated by a matrix element of the order of the Fermi-constant times the CP-violating parameter times the squared electric charge. A renewed experimental search for the decay $\mu^+ \to e^+e^+e^-$ with a branching ratio of about $4 \times 10^{-9}$ is recommended. (NL)

**13429** MODEL INDEPENDENT TESTS FOR THE $\Delta I = \frac{1}{2}$ RULE IN Σ DECAYS. Ion, D. B. (Joint Inst. for Nuclear Research, Dubna (USSR)). Nucl. Phys., B; 96: No. 1, 67-76(15 Sep 1975).

The equalities resulting from the triangular relationships and certain tests for the $\Delta I = \frac{1}{2}$ rule in Σ decays have been investigated. Numerical results and an estimation of the $\Delta I = \frac{1}{2}$ breaking are presented. It is found that a single breaking parameter may account for the departures from the exact $\Delta I = \frac{1}{2}$ rule for both the parity-violating and parity-conserving decay amplitudes. The additional constraints imposed on the experimental data, when the decay amplitudes are taken to be real, are discussed. (NL)

## *Applications (Strong)*

**13430** INDEPENDENT DETERMINATION OF $SU_3$ COUPLINGS FROM INCLUSIVE SPECTRA. Low, H. B. (Nanyang Univ., Singapore, China); Phua, K. K.; Lo, S. Y. Nuovo Cim.; 30A: No. 2, 221-234(21 Nov 1975).

From an investigation of the inclusive spectra near the phase-space boundary one obtains an independent determination of the following $SU_3$ couplings: $(g_{NAK}/g_{NEK})^2 = 4.2$ with $\alpha = 0.28$, $(g^2_{NEK} + g^2_{NAK})/4\pi \approx 7.2$ and $g^2_{NEK}/g^2_{NN\pi} = 0.24$ with $\alpha = 0.26$. (auth)

**13431** REMARKS ABOUT A SPONTANEOUS BREAKDOWN OF HADRONIC SYMMETRICS. Hosek, J. (Ustav Jaderne Fyziky, Rez (Czechoslovakia)). Acta Phys. Slovaca; 24: No. 3, 189-196 (1974).

From triangle meeting on weak interactions; Smolenice, Czechoslovakia (4 Jun 1973).

It is shown that the use of more multiplets of scalar fields which all transform according to the complex fundamental representations of the U(n) group in a plasmon generating mechanism of the U(n) gauge group has to be taken with a reserve. The same holds when using (again for the U(n) gauge group) a scalar multiplet transforming according to the (n,n*) + (n*,n) representation of the U(n) group. (auth)

**13432** PARITY, BARYON NUMBER AND SUPERSYMMETRY. Grosser, D. (Tuebingen Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., B; 94: No. 3, 513-518 (18 Aug 1975).

Space reflection induces a transformation in the pseudo-Lie algebra of generators of symmetries and supersymmetries. If there is a supermultiplet in the theory in which the baryon number is zero for bosons and ± 1 for fermions then the structure of the pseudo-Lie algebra is simple and therefore the space

reflection transformation can be studied in detail. It turns out that the space reflection transformation fixes uniquely the structure of the pseudo-Lie algebra as far as the generators of supersymmetries are concerned. (auth)

**13433** TIME REVERSAL VIOLATION IN THE NUCLEON-NUCLEON SYSTEM. Simonius, M. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Kernphysik). Phys. Lett., B; 58: No. 2, 147-151(1 Sep 1975).

T-violation in the N-N system is reconsidered with emphasis on possible boson exchange interactions. A theorem on restrictions on the total spin and parity of the exchanged system of bosons is proved and its consequences are discussed. (NL)

## Scattering Theory

*Refer also to abstracts 13215, 13741, 13773, and 13778.*

**13434** (JINR-P1, 2-8529, pp 97-143) ANALYTICITY, UNITARITY, AND LIMITATIONS ON THE SCATTERING AMPLITUDE AT FINITE ENERGIES. Vernov, Yu. S. (Inst. of Nuclear Research, Moscow). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

Some rigorous consequences of unitarity, analyticity, and crossing symmetry are discussed. The dependence of the behavior of the scattering amplitude at finite energies on the ratio of its real part to its imaginary part is examined. This dependence and the limitations on scattering amplitude following from it is studied at asymptotic energies. Asymptotic limitations and phase limitations are first considered. Then the basic assumptions made in the analysis are given. Dispersion relations for amplitude logarithms and the integral ratios are found. Limitations on the amplitude ratio of particles and antiparticles are considered. (JSR)

**13435** (JINR-P1, 2-8529, pp 374-396) ASYMPTOTIC PROPERTIES OF THE FEYNMANN AMPLITUDE. Mineev, V. S.; Frenkin, A. R. (Moscow State Univ.). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

Traditional methods for the calculation of the principal terms of the asymptotic expansion of Feynmann amplitudes are described. A new method for the investigation of the asymptotics of Feynmann graphs is developed. It is connected with the use of conditions of unitarity. The criterion of asymptotic behavior of Feynmann amplitudes (linearity condition) was obtained. It was shown that an examination based on the Mellin transforms leads to analogous results. The discussion was illustrated in the example of fifth order vertex diagrams. (JSR)

**13436** (JINR-P1, 2-8529, pp 492-503) CONTINUAL INTEGRAL IN THE PERTURBATION THEORY. Slavnov, A. A. (Mathematics Inst., Moscow). 1975. (In Russian).

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

An examination showed that all those properties of the Feynmann integral which must be used in the perturbation theory come directly from the determination of the quasi-Gaussian integral and can be rigorously validated independently of the question of existence of the Feynmann integral dimensions. Therefore, in the framework of the perturbation theory the formalism of the continual integral is a very rigorous mathematical method, equivalent to the usual diagram technique. (JSR)

**13437** SOME TOPICS IN MULTI-CHANNEL ANALYSIS. Ferrando, A. (JEN, Madrid). pp 177-382 of Proceedings of the 3rd International Winter Meeting on Fundamental Physics. Bejarano, J. D. (ed.). Madrid; Instituto de Estudios Nucleares (1975).

From 3rd international meeting on fundamental physics; Sierra Nevada, Spain (10 Feb 1975). See CONF-750242-.

A brief review is given of some of the mathematical methods and those induced by the physics of multiparticle processes for low multiplicity analysis is given. Included are clusters and dimensions, an example of vector clustering techniques, the relation of blood and particles, prism plot analysis, applications of the prism plot analysis to $\pi^- p \to p\pi^+ 2\pi^-$ at 3.9 GeV/c and to $K^+ p \to pK^0\pi^-$ at 5.0 GeV/c, prism plot analysis with simulated events, possible clusters in full dimensional space, variants of the PPA, and analytical multichannel analysis. (JFP)

**13438** ALGEBRA OF CURRENTS AND REGGE COUPLINGS. Kleinert, H. (Freie Univ., Berlin). pp 356-366 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

An attempt is reported on obtaining a joint algebraic understanding of observables of local currents of any spin J and Regge couplings together. It is shown that algebraic saturation schemes of chiral SU(2) × SU(2) can naturally be extended by Regge couplings to form a larger algebra. In particular, isospin $T_a$, axial charge $X_a$, and the residues of $\rho_a$, $A_{1a}$, $\pi_a$, and f trajectories form the superalgebra SU(2) × SU(2) × 0(5), and that the superalgebra is closely related to the algebra of bilocal form factors. (JFP)

**13439** GENERALIZED GELL-MANN-GOLDBERGER TRANSFORMATION FOR MANY-BODY SCATTERING. Cattapan, G. (Univ., Padua); Vanzani, V. Lett. Nuovo Cim.; 14: No. 13, 465-470(29 Nov 1975).

A further advantage of the symmetric transition operators with respect to the asymmetric conventional ones is pointed out. Starting from symmetric operators, one directly arrives at a generalized Gell-Mann-Goldberger formula for many-body multichannel scattering which closely corresponds to the well known two-potential formula for two-body scattering. The formula is derived in a natural way, in an N-body context, without making any assumption and without resorting to ingenious formal devices as is usual in standard three-body procedures. (JFP)

**13440** ALGEBRA OF GENERAL COVARIANCE GROUP IN SUPERSPACE AS THE CLOSURE OF ALGEBRAS OF SUPERCONFORMAL, SUPERGAUGE, AND LINEAR GROUPS. Srivastava, P. P. (Univ. Federal, Rio de Janeiro). Lett. Nuovo Cim.; 14: No. 13, 471-474(29 Nov 1975).

It is shown that the algebra of the infinite-dimensional general covariance group over superspace is the closure of the algebras of its three-dimensional general covariance group over superspace is the closure of the algebras of its three finite-parameter subgroups: the special linear group, the superconformal group, and a four-parameter supergauge group. It is proven that any generator of the equation for a local gauge group of arbitrary coordinate transformations in superspace $z'^A = z^A(z)$ may be expressed as some linear combination of repeated modified commutators of the generators of these subgroups. The result is a generalization of a similar theorem over the Minkowski space where only special linear and conformal subgroups are required. (JFP)

**13441** BACKLUND TRANSFORMATIONS AND FUNCTIONAL RELATION FOR SOLUTIONS OF NONLINEAR PARTIAL DIFFERENTIAL EQUATIONS SOLVABLE VIA THE INVERSE SCATTERING METHOD. Calogero, F. (Univ., Rome). Lett. Nuovo Cim.; 14: No. 15, 537-543(13 Dec 1975).

A previous approach is used to derive a set of Baecklund transformations, i.e., relations connecting different solutions of the studied nonlinear partial differential equations (NLPDE's). In this manner one reobtains the beautiful results first found for the KdV equation. The origin of these results is thereby clarified; they are moreover extended by the introduction of more general transformations, and they are shown to apply to a large class of NLPDE (possibly involving several variables). One also derives, for all the NLPDE's of this class that involve only one space variable, a remarkable functional equation relating the solution at time t to the same solution at time t + Δt (with Δt infinite). (JFP)

**13442** INTRODUCTION TO RELATIVISTIC SCATTERING THEORY. Scheck, F. (SIN, Villigen, and ETH, Zurich). pp 121-137 of Investigation of Nuclear Structure by Scattering Processes at High Energies. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From international school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974). See CONF-7409109-.

An illustration is given of one example in electromagnetic interactions, the elastic scattering of a high energy electron off a spin-zero target, which will demonstrate how far one can go with the familiar methods of conventional scattering theory. A few well-known results in relativistic scattering theory are then reviewed, with an eye on their counterparts in non-relativistic potential theory. In the choice of these selected topics, we are guided by the needs of theoretical intermediate energy physics and by what is already known from potential theory. (auth)

**13443** PARTICLE MIXING AND CHARGE ASYMMETRIC NUCLEAR FORCES. McNamee, P. C.; Scadron, M. D.; Coon, S. A. (Arizona Univ., Tucson (USA). Dept. of Physics). Nucl. Phys., A; 249: No. 3, 483-492(22 Sep 1975).

The charge asymmetric effect of $\rho\omega$ and $\pi\eta$ electromagnetic mixing on the $^1S_0$ NN potential is reviewed. It is found that the $\rho\omega$ contribution dominates and leads to an n-n potential which is more attractive than the p-p potential. The shift in the scattering lengths is then calculated to be mod($a_{nn}$)-mod($a_{pp}$) approximately 0.9 fm and the shift in effective ranges is $r_{nn}$-$r_{pp}$ approximately −0.02 fm. (NL)

**13444** ASYMPTOTIC BEHAVIOR OF THE FORM FACTOR FOR NON-RELATIVISTIC MANY-BODY SYSTEMS. Narodetskii, I. M.; Simonov, Yu. A. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow. Inst. Teoreticheskoj i Ehksperimental'noj Fiziki); Palumbo, F. (Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratori Nazionali di Frascati). Phys. Lett., B; 58: No. 2, 125-128(1 Sep 1975).

The asymptotic behavior of the form factor for non-relativistic bound systems is derived for local and nonlocal two- and three-body potentials taking into account the Pauli principle. The effect of the Pauli principle is very important, giving rise to the extra factor $q^{-K_{min}}$, where $K_{min}$ is the minimum degree in the homogeneous polynomials expansion, which grows like $A^{\frac{1}{3}}$ for large particle number A. (NL)

**13445** COMPLEX GENERATOR COORDINATE METHOD IN THE SCATTERING PROBLEM. Hara, K.; Takigawa, N. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.). Phys. Lett., B; 58: No. 2, 135-138(1 Sep 1975).

An extension to complex generator coordinates by using moving wave packets is proposed and the well-known difficulties associated with the real generator coordinate method are resolved. Due to the completeness of the moving wave packet functions the Hill-Wheeler integral equation can be transformed into an equation which is familiar in the resonating group method. (NL)

**13446** ABRAMOVSKII, KANCHELI, GRIBOV REGGEON CUTTING RULES. Koplik, J.; Mueller, A. H. (Columbia Univ., New York (USA). Dept. of Physics). Phys. Lett., B; 58: No. 2, 166-170(1 Sep 1975).

A simple derivation of the Reggeon cutting rules of Abramovskii, Kancheli, and Gribov is presented. The argument is based on multiple scattering off spatially-separated hadrons in softened field theory, and some remarks on the generality of the rules are included. (NL)

**13447** SCATTERING-EQUIVALENT MULTICHANNEL SYSTEMS AND n-BODY ($n \geq 3$) NUCLEAR FORCES. Saenz, A. W.; Zachary, W. W. (Naval Research Lab., Washington, D. C. (USA)). Phys. Lett., B; 58: No. 1, 13-16(18 Aug 1975).

Rigorous conditions are given for two nonrelativistic N-particle ($N \geq 2$) systems with unitarily equivalent Hamiltonians to yield the same scattering amplitudes. This allows the phenomenological investigation of n-body ($n \geq 3$) nuclear forces by varying nuclear bound-state wave-functions while leaving unaltered the pertinent scattering predictions. (NL)

**13448** CAUSAL BOUNDS FOR TIME DELAY. Nowakowski, J.; Osborn, T. A. (Brooklyn Coll., N. Y. (USA)). Nucl. Phys., A; 249: No. 2, 301-319(15 Sep 1975).

New and stronger causal bounds are presented for time delay in two-body scattering. For cut-off potentials, with a finite range of support, a Wigner-like bound that is valid for all partial waves is found. The form of this bound can be presented in terms of a universal function, which depends only on the angular momentum, the incident momentum and the range of the forces. Bounds associated with this function are progressively more restrictive as the angular momentum, l, increases. Further by employing the variable-phase approach to scattering new methods are developed for obtaining causal bounds for infinite-ranged forces. These bounds are valid for all l. (NL)

**13449** UPPER BOUND ON THE SLOPE PARAMETER. Uchiyama, T. (Kyoto Univ. (Japan). Research Inst. for Fundamental Physics). Nucl. Phys., B; 96: No. 1, 186-188(15 Sep 1975).

The axiomatic upper bound is found on the slope parameter of the scattering amplitude, which is logarithmically divergent with respect to energies in the region $0 < t < 4m_\pi^2$. This upper bound is realized in Regge-pole theory. The numerical upper bound on the slope parameter of the linear Regge trajectory is also found explicitly. (NL)

# PHYSICS (LOW-TEMPERATURE)

## Superconductivity

*Refer also to abstracts 12564, 12602, 12603, 12607, 12623, 12643, 12644, 12647, 12650, and 13325.*

13450 SUPERCONDUCTORS IN GRAVITATIONAL FIELD. Hirakawa, H. (Tokyo Univ.). Phys. Lett.; 53A: No. 5, 395-396(14 Jul 1975).

The classical London equations in a covariant form hold for superconductors in a curved space-time. Gravity effects of superconducting bodies at 0°K are discussed. (auth)

# PHYSICS (NUCLEAR)

**13451** (ANL-75-75) PHYSICS DIVISION ANNUAL REVIEW, 1 APRIL 1974-31 MARCH 1975. Bollinger, L. M. (Argonne National Lab., Ill. (USA)). 1975. Contract W-31-109-Eng-38. 310p. Dep. NTIS $10.75.

Work is reported in the areas of intermediate-energy physics, heavy-ion physics, light-ion physics, accelerator operations, superconducting linac development, neutron physics, theoretical physics, and atomic and molecular physics. Lists of publications and staff members are also included. Much of the work reported has been or will be published. Unpublished research reports containing significant amounts of information are listed separately by title. (RWR)

*For titles of individual papers see: 12961–12963, 13002, 13451, 13465, 13484, 13485, 13518, 13534–13539, 13564, 13586–13588, and 13641.*

**13452** (INS-688) REPORT ON THE WORK OF THE INSTITUTE OF NUCLEAR SCIENCES. Progress Report 23, January-June 1974. Rafter, T. A. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Sep 1974. 151p. Dep. NTIS (US Sales Only) $10.75.

Work is described in the fields of nuclear physics, radiation research, isotope geochemistry-stable isotopes, radioactive dating and fallout, radioisotope applications, instrumentation, and theoretical physics. Systematic errors were found in the published transition intensities of $^{56}$Co and $^{66}$Ga. The role of the superoxide radical ion in biochemical reactions was investigated. Experiments on the reaction of hydroperoxy radical with $NO_2$ were carried out. The effects of gamma radiation on perspex were investigated. Isotope ratios in ground waters and rocks were measured. Radioisotope tracers were used to study water flow patterns. Work on separating U and Th from carbonate samples by use of a two-stage split cation exchange system continued. A nuclear structure theory based on reduced density matrices was further developed. (6 figures, 7 tables) (RWR)

**13453** (INS-726) REPORT ON THE WORK OF THE INSTITUTE OF NUCLEAR SCIENCES. Progress Report 24, July-December 1974. Rafter, T. A. (Department of Scientific and Industrial Research, Lower Hutt (New Zealand). Inst. of Nuclear Sciences). Feb 1975. 149p. Dep. NTIS (US Sales Only) $10.50.

Research is reported in the fields of nuclear physics, radiation research, isotope geochemistry-stable isotopes, radioactive dating and fallout, radioisotope applications, instrumentation, and theoretical physics. The role of the superoxide radical ion in normal and abnormal hemolytic conditions was studied. Improvements in the interpretation of isotopic analyses of hydro-thermal barites were made. The earlier French bomb test in 1974 was found to have a fallout composition suggesting a Pu explosive rather than the later U tests. Underground hot water velocities in the Broadlands geothermal field were measured. Good correlations were found between densities and radiometrically determined densities using a transmission method. A model for the fallout of fission products was developed; it allows the prediction of the eventual total fallout of a long-lived isotope given the total fallout of some short-lived isotope. (5 figures, 3 tables) (RWR)

**13454** (NP-20600) ANNUAL REPORT, 1974. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica; Instituut voor Kernphysisch Onderzoek, Amsterdam (Netherlands)). 1974. 249p. (In Dutch). Dep. NTIS (US Sales Only) $15.50.

This annual report of the Foundation for Fundamental Research on Matter reports research in the fields of nuclear physics, atomic physics, metals, molecular physics, solid state physics, thermonuclear research and plasma physics, and high-energy physics. The memberships of various special commissions are also included. (RWR)

**13455** NEUTRON CAPTURE GAMMA-RAY SPECTROSCOPY. Proceedings of the Second International Symposium on Neutron Capture Gamma Ray Spectroscopy and Related Topics, Held in Petten, the Netherlands, September 2-6, 1974. Petten, Netherlands; Reactor Centrum Nederland (1975). 813p. (CONF-740920-).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974).

Separate abstracts appear for each of the 106 papers included in the proceedings. (SDF)

*For abstracts of individual papers see: 11432, 11433, 12096, 12097, 12130–12135, 13474, 13475, 13515, 13524–13528, 13546–13557, 13570–13580, 13596–13623, 13646–13655, 13667–13670, 13692–13700, 13751–13759, and 14038–14042.*

**13456** NUCLEAR REACTIONS. Detraz, C. (Centre National de la Recherche Scientifique, 75- Paris (France)). Recherche (Paris); 6: No. 56, 418-429(May 1975). (In French).

New prospects are envisaged for nuclear physics, for the theory and also the probes used. New reaction types and new concepts have been discovered, such as the viscosity and friction concepts especially important in the case of high-velocity heavy-ion reactions. (FR)

**13457** NUCLEAR ENERGY: AN INTRODUCTION TO THE CONCEPTS, SYSTEMS, AND APPLICATIONS OF NUCLEAR PROCESSES. Murray, R. L. Oxford; Pergamon Press Ltd. (1975). 295p. $14.50.

A description of basic nuclear phenomena is provided, devices and processes that involved nuclear reactions are described, and attention is called to the problems and opportunities inherent in a nuclear age. Emphasis is first placed on energy, atoms and nuclei and nuclear reactions. Operating principles of radiation equipment, nuclear reactors, and other systems involving nuclear processes are described, giving quantitative information wherever possible. Finally, attention is directed to the subjects of radiation protection, beneficial usage of radiation, and the connection between energy resources and human progress. (GHT)

## Neutron Interactions with Matter

*Refer also to abstracts 12705 and 12980.*

**13458** (AWRE-O- 13/75) GUIDE TO GALAXY 6 PART 1. Price, J. A. (UKAEA Weapons Group, Aldermaston. Atomic Weapons Research Establishment). Nov. 1975. 76p. Dep. NTIS (US Sales Only) $6.00. UK £1.50.

GALAXY 6 Part 1 is a program to compute spectrum-weighted, group-averaged nuclear cross sections and group-to-group transfer cross sections from the evaluated microscopic cross section data contained in the UKAEA Nuclear Data Library. A description is given of the input and output schemes and operating procedures for the IBM 370/168, together with the structure and functioning of the program and other relevant topics. (auth)

**13459** (CONF-751209-19) ANALYSIS OF MAGNETIC NEUTRON SCATTERING DATA. Felcher, G.; Garland, J. W.; Cable, J. W.; Medina, R. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. 9p. Dep. NTIS $4.50.

From 21st annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

The determination of the proper magnetic form factors for use in the analysis of diffuse-scattering data is discussed, and that information which is immediately available from such data is considered. Apparent discrepancies between the results of diffuse scattering and diffraction experiments on ferromagnetic Ni-Cu alloys are resolved. It is shown that the data indicate that the negative spin density usually attributed to conduction electrons instead arises largely from the overlap of localized wavefunctions, as was first suggested by Moon. 3 figures. (auth)

**13460** (JAERI-M-5963) APPROXIMATE EXPRESSION OF COLLISION DENSITY AND CORRECTION OF GROUP ELASTIC REMOVAL CROSS SECTION NEAR A WIDE SCATTERING RESONANCE. Kikuchi, Y.; Katsuragi, S. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 23p. INIS.

An analytical expression of collision density has been developed. The collision density is well represented with this expression for mixtures composed of sodium and lighter nuclides. The present expression has a considerable error for mixtures containing iron, and the conventional asymptotic solution was temporarily adopted for this case. The elastic removal cross section contained in the JAERI-Fast set was corrected by using the flux calculated with the present method. The errors of the result thus obtained are less than 10 percent at most near the sodium resonance, while they are of a factor of 2 or 3 without correction. The effect of the sodium resonance can be reflected on the elastic removal cross section of other scattering nuclides for which such an effect is ignored in the original JAERI-Fast set. Thus the applicability of the group constants of coarse group structure (with less than 100 groups) is much enlarged by the present correction. (auth)

**13461** DYNAMICAL THEORY OF MAGNETIC DIFFRACTION OF NEUTRONS. Sivardiere, J. (CEN, Grenoble, France). Acta Crystallogr., Sect. A; 31: No. 3, 340-344(1 May 1975). (In French).

The dynamical theory of magnetic diffraction of neutrons is investigated within the two-wave approximation. In ferromagnets the dispersion surface Σ is of order 4: quadrupole refraction and diffraction are found; in general the wave fields are not polarized. In antiferromagnets, Σ is in general made of two hyperboloids, each of them corresponding to a given polarization of the propagating neutron. (auth)

**13462** NEUTRON-ABSORPTION CROSS SECTIONS OF SOME RADIOACTIVE NUCLIDES. Elgart, M. F. (City Univ., New York); Finston, H. L.; Rundberg, R.; Williams, E. T.; Bond, A. H. Jr.; Yellin, E. Nucl. Sci. Eng.; 58: No. 3, 291-297(Nov 1975).

We describe a simple method for determining the neutron-absorption cross sections of radioactive nuclides and its application to $^{22}Na$ and $^{126}I$. These nuclides are produced by fast-neutron reactions in cadmium-wrapped and unshielded samples simultaneously irradiated with cobalt flux wires. Values for the thermal cross section, $sigma_0$, the resonance integral, SIGMA', and $s_0$ are calculated from the data using the Westcott convention. The results are as follows: for $^{22}Na$, $sigma_0$ equals $(5.11 \pm 0.31) \times 10^4$ b, $s_0$ equals $2.3 \pm 0.1$, and SIGMA' equals $(1.0 \pm 0.1) \times 10^5$ b; for $^{126}I$, $sigma_0$ equals $(9.0 \pm 5.0) \times 10^3$ b. (1 figure, 4 tables) (auth)

**13463** NONASYMPTOTIC NEUTRON SPECTRUM IN A TWO-COMPONENT MEDIUM WITH ENERGY-DEPENDENT CROSS SECTIONS. Platonov, A. P.; Luk'yanov, A. A. Sov. J. At. Energy (Engl. Transl.); 33: No. 6, vp.(Dec 1972).

Translated from At. Energ. (USSR); 33: No. 3, 985-986(Dec 1972). This is a summary of paper No. 627/6778 with full copy held at TIC.

In a number of problems of neutron slowing-down theory it is necessary to take into account nonasymptotic (Placzek) oscillations of the neutron collision density which can occur in a mixture of light and heavy nuclei. An exact calculation of the Placzek function is made by using an algorithm for the solution of the slowing-down equation in a multicomponent medium without any assumptions about the character of the energy dependence of the cross sections of the elements. This algorithm is based on the reduction of the integral slowing-down equation with a monoenergetic source, whose solution has discontinuities of the first kind, to a differential equation with a retarded argument whose solution has discontinuities at these same points on the energy axis, and the use of familiar numerical methods, such as the Adams method, for solving the differential equation. This algorithm allowed us to determine correctly the behavior of the neutron collision density close to the source energy and to calculate the asymptotic behavior of the Placzek function. As an example, the main features of the behavior of the Placzek function have been examined in a two-component hydrogeneous medium. The calculations permit an estimate of the validity of the narrow resonance approximation; for periods less than the magnitude of the maximum energy loss in elastic scattering from nuclei of the heavy component the asymptotic collision density does not depend on energy. Obviously the same result will hold for broad resonances and only for intermediate resonances does the asymptotic collision density oscillate periodically with energy, correlated with the energy structure of the cross section. This effect can be important in calculating the effective resonance integral in individual energy groups, in averaging the group cross sections, and in analyzing the nuclear temperature effect in a fast reactor. 4 figures. (auth)

# Nuclear Properties and Reactions, A ≤ 5

*Refer also to abstracts 13171, 13483, and 13776.*

**13464** (AECL-5226, pp 52-53) SEARCH FOR TWO-PHOTON DECAY IN THERMAL np CAPTURE. Earle, E. D.; Lone, M. A.; McDonald, A. B.; Haeusser, O. Aug 1975.

In Physics Division progress report, April 1-June 30, 1975.

**13465** (ANL-75-75, pp 122-123) PHOTODISINTEGRATION OF THE DEUTERON NEAR THRESHOLD. Jackson, H. E.; Holt, R. J.; Wilson, W. M. 1975.

In Physics Division annual review, 1 April 1974-31 March 1975. (Argonne National Lab., Ill. (USA)).

**13466** (CEA-N-1791, pp 139-140) DATA ANALYSIS FOR THE REACTION $^4He(\gamma,p\pi^-)$. Argan, P.; Audit, G.; de Botton, N.; Faure, J. L.; Laget, J. M.; Martin, J.; Tamas, G. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973-30 September 1974.

A new analysis of the results of the $^4He(\gamma,p\pi^-)$ reaction was done taking into account more carefully the variation of the kinematical conditions in the detectors. The observed anomaly remains. (FR)

**13467** (DP-MS-75-95) PHOTONEUTRON CROSS SECTIONS FOR $D_2O$ AND BERYLLIUM. Bowsher, H. F.; Woods, F. J.; Baumann, N. P. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA), Savannah River Lab.). 1975. Contract AT(07-2)-1. 11p. (CONF-751147-1). Dep. NTIS $4.50.

From American Physical Society southeastern sectional meeting; Auburn, Alabama, USA (13 Nov 1975).

The photodissociation cross section by $^{24}Na$ gamma rays was measured for deuterium in order to resolve a discrepancy between earlier measurements (1.43 to 1.59 millibarns) and a more recently reported one (1.34 mb). The measurement of the beryllium (gamma, n) cross section for $^{24}Na$ gamma rays was also included as a check. Results for deuterium (1.54 mb) are in agreement with the earlier values. (SDF)

**13468** (INIS-mf-1811) AMBIGUITIES IN PHASE-SHIFT ANALYSIS. de Roo, M. (Rijksuniversiteit Groningen (Netherlands)). 1974. 104p. INIS.

It is shown that even in the idealized situation where angular distributions are known without experimental uncertainties for all scattering angles, there are serious ambiguities in phase-shift analysis. Methods for the construction of discrete and continuum ambiguities are presented, and these methods applied to the case of $\alpha\alpha$-scattering. The problem of Coulomb effects is discussed. (INIS)

**13469** (INIS-mf-1829) ANALYSIS OF QUASI-ELASTIC SCATTERING AND FINAL STATE INTERACTION IN THE D(p,pn)p REACTION AT 156 MeV. vel Lebjman, I. D. G. (Sao Paulo Univ. (Brazil). Instituto de Fisica). 1972. 77p. (In Portuguese). INIS.

Thesis.

Three-body scattering is studied, with emphasis on the process limits: Quasi-Elastic Scattering and Final-State Interaction. Phenomenological models are discussed. The cross section $d^3\sigma/(d\Omega_n\, d\Omega\, dE_p$ of the D(p,pn)p reaction at 156 MeV is calculated using an approximation which assumes to be a wave function of proton-proton scattering separable in the summation of the wave functions, a regular Coulombian and a scattered part developed in the usual series. Comparison is made with experimental values obtained at $\Theta_p = 45°$ and $\Theta_n = -55°$, and $\Theta_p = 52.5°$ and $\Theta_n = -35°$, showing that good agreement can be obtained, if for the first pair of angles the third Moravcsih approximation is used for the deuteron wave function. The second pair of angles, where the Final-State Interaction process is weak, is less sensitive to the choice of the deuteron wave function. The existence of two peaks in the proton spectra in the energy region corresponding to the predominance of the Final-State Interaction process is classified. (auth)

**13470** (LBL-3849) NUCLEUS-NUCLEUS TOTAL CROSS SECTIONS FOR LIGHT NUCLEI AT 1.55 AND 2.89 GeV/C/NUCLEON. Jaros, J. A. (California Univ., Davis (USA). Dept. of Engineering). Nov 1975. Contract W-7405-ENG-48. 121p. Dep. NTIS $6.50.

Thesis.

Total cross sections have been measured for protons, deuterons, alphas, and $^{12}C$ on hydrogen, deuterium, helium, and carbon targets at 1.55 and 2.89 GeV/c/nucleon using the "good geometry" transmission method. In addition, the inelastic cross sections and elastic slope parameters were measured for reactions initiated by deuterons, alphas, and $^{12}C$. The factorization relation sigma/sub T/(AA) equals sigma/sub T/$(AB)^2$/sigma/sub T/(BB) is violated for some of these reactions. The results generally agree with Glauber theory predictions except in their detailed energy behavior. It is found that sigma/sub T/ approximately equal to 144 (A/sub T//sup ⅓/ + A/sub P//sup ⅓/ - 1.48)$^2$ and sigma/sub IN/ approximately equal to 78 (A/sub T//sup ⅓/ + A/sub P//sup ⅓/ - 1.25)$^2$, where A/sub T/(A/sub P/) is the atomic mass number of the target (projectile) and the cross sections are given in mb. (auth)

**13471** (ORO-4699-2) STUDY OF THE TWO-BODY DISSOCIATION OF LIGHT NUCLEI IN NUCLEAR FIELDS. Progress Report, January 1, 1975-December 31, 1975. Kirk, P. N.; Huggett, R. W. (Louisiana State Univ. and Agricultural and Mechanical Coll., Baton Rouge, La. (USA)). 1975. 29p. Dep. NTIS $5.00.

The objective of the experiment is to measure the frequency with which nucleons within a parent nucleus coalesce into clusters.

The experiment will be carried out at the Bevatron with heavy ion beams of 2.1 GeV per nucleon. The extracted heavy ion beam will be directed onto a target in which many interactions will occur. The interactions of interest will be those in which the incident nucleus fragments into two daughter nuclei. These events will be selected from the background by scintillation counters and associated fast electronics. A list of projects started or completed at LSU the past year is given. (auth)

**13472** (ORO-4856-41) RECOIL AND STRONG FORMFACTOR EFFECTS IN MESONIC EXCHANGE CORRECTIONS ON THE CHARGE DISTRIBUTION OF $^3$He AND $^3$H. Kloet, W. M.; Tjon, J. A. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Nov 1975. 14p. Dep. NTIS $3.50.

Effects of meson exchange on the charge distribution of $^3$He and $^3$H are determined, including intermediate nucleon-antinucleon states, pion-nucleon resonances and recoil effects. The role of a strong interaction form factor in these effects is discussed. The calculation is based on a tri-nucleon wave function obtained from the Reid soft core potential. (auth)

**13473** ($\alpha$,p) AND ($\alpha$,d) REACTIONS ON LITHIUM AND CARBON NUCLEI AND TESTS OF THRESHOLD STATES. Burtebaev, N. T.; Vinogradov, A. A.; Vongai, A. D. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 59-64(1975). (In Russian)

Reactions were studied with two- and three-nucleon transfers due to 50.5-MeV $\alpha$ particle bombardment of $^6$Li, $^7$Li, and $^{12}$C nuclei. The results were compared with data from the ($^6$Li, $\alpha$) and ($^7$Li,$\alpha$) reactions. In the ($\alpha$,p) and ($\alpha$,d) reactions the excitation of threshold deuteron and triton states was considerably less probable than in the ($^6$Li, $\alpha$) and ($^7$Li, $\alpha$) reactions, and the ($\alpha$,p) reaction with activation of high-lying states on the $^{12}$C nucleus had a high selectivity. (tr-auth)

**13474** NEUTRONS AND GAMMA-RAY STRENGTHS. Endt, P. M. (Rijksuniversiteit, Utrecht). pp 17-27 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

In the analysis of high-resolution neutron capture $\gamma$-ray spectra one encounters many difficulties of which some are discussed. To arrive at unambiguous bound-state spins and parities, one generally needs the strengths of secondary $\gamma$-rays as determined from lifetimes, branching and mixing ratios. A new method of DSA lifetime measurements at high recoil velocities is described, in which the accuracy is increased by a factor of 10 compared to conventional low-velocity DSA measurements. Statistics are presented on the strengths of some 1000 $\gamma$-ray transitions between bound states in light nuclei (A < 45), from which recommended strength upper limits are derived for transitions classified according to character (E or M), multipolarity and isospin forbiddenness. (1 table, 4 figures) (auth)

**13475** GAMMA RAY CALIBRATION FROM MASS DATA. Wapstra, A. H. (Technological Univ., Delft, Netherlands). pp 686-690 of Neutron Capture Gamma-ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Neutron binding energies calculated from atomic mass measurements in the late Dr. Lincoln Smith's Radio Frequency Mass Spectrometer on $^3$T, $^{13}$C, $^{14}$C and $^{15}$N are used to improve considerably the precision of some capture gamma-ray energy standards. (auth)

**13476** KAON-NUCLEON PARTIAL-WAVE AMPLITUDES BELOW 1.5 GeV/c FOR I = 0 AND 1. Martin, B. R. (University Coll., London (UK)). Nucl. Phys., B; 94: No. 3, 413-430 (18 Aug 1975).

Kaon-nucleon partial-wave amplitudes for isospin I = 0 and 1 are presented from a simultaneous phase-shift analysis of $K^+p$ and $K^+d$ data in the region below 1.5 GeV/c kaon lab momentum. (auth)

**13477** $K^+n$ ELASTIC AND CHARGE-EXCHANGE SCATTERING BETWEEN 430 AND 940 MeV/c. Damerell, C.J.S.; Hotchkiss, M. J.; Wickens, F. (Science Research Council, Chilton (UK). Rutherford Lab.); Bentley, K. R.; Davies, J. D.; Dowell, J. D.; Homer, R. J.; McLeod, C.; McMahon, T. J.; van der Raay, H. B. Nucl. Phys., B; 94: No. 3, 374-412(18 Aug 1975).

Elastic and charge-exchange $K^+n$ differential cross sections have been measured from $K^+d$ interactions from 430 to 940 MeV/c using spark chambers and scintillation counters. The data have been compared with existing results and in an accompanying paper have been included with other measurements in a phase-shift analysis. (auth)

**13478** EFFECTS OF SHORT-RANGE CORRELATION AND DISTORTION IN THE REACTION $^4$He(e,e'p)$^3$H. Jibuti, R. I.; Kezerashvili, R. Ya. (Tbilisskij Gosudarstvennyj Univ. (USSR)). Phys. Lett., B; 57: No. 5, 433-437(4 Aug 1975).

An attempt is made to give a coherent explanation of the elastic and quasielastic electron scattering from $^4$He. It is shown that the short-range correlations and distortion effects in the reaction $^4$He(e,e'p)$^3$H modify qualitatively the cross section for large momentum. (auth)

**13479** CLUSTER ISOBARIC STATES. Benisz, J. (Univ. of Silesia, Katowice, Poland). Acta Phys. Acad. Sci. Hung.; 38: No. 3, 253-260(1975).

The existence of isobaric states of x-clusters and the influence of isobaric states on the energy and half life of $\gamma$-decay are analyzed. For the explanation of the linear dependence of the maximum energy of $\beta^+$-decay against the number of $\alpha$-clusters and also for the half life as a function of the number of $\alpha$-clusters nuclear Coulomb and cluster properties are taken into consideration. (auth)

**13480** PROTON-PROTON BREMSSTRAHLUNG AT 11 AND 13 MeV. Suter, M.; Woelfli, W.; Bonani, G.; Stoller, C.; Mueller, R. (Eidgenoessische Technische Hochschule, Zurich (Switzerland). Lab. fuer Kernphysik). Phys. Lett., B; 58: No. 1, 36-38 (18 Aug 1975).

The p-p bremsstrahlung cross sections were measured at two energies using the equal angle Harvard geometry with $\theta_{lab} = 30^0$. The results corrected for noncoplanarity are $0.43 \pm 0.03$ $\mu$b/sr$^2$ at 11 MeV and $0.44 \pm 0.05$ $\mu$b/sr$^2$ at 13 MeV. (NL)

**13481** CLUSTER ANALYSIS OF $^{6,7}$Li BY MEANS OF ($\alpha$, 2$\alpha$) REACTIONS. Mithra, B.; Laverriere, R. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Phys. Lett., B; 58: No. 1, 17-20(18 Aug 1975).

The ($\alpha$-d) and ($\alpha$-t) structures of $^{6,7}$Li are studied by means of ($\alpha$,2$\alpha$) reactions at intermediate energies in a formalism using polar and triangular Feynman graphs. The results show that the expected structure for $^6$Li is compatible with a 1s state function but for $^7$Li the 1p state does not agree. The $\alpha$ effective number for $^6$Li, 0.92, independent of the incident energy, is in good agreement with the expected value. (NL)

**13482** OFF DIAGONAL INTERACTION SPIN DEPENDENCE IN $^3$He(d,p)$^4$He REACTION. Yasnogorodskii, A. M. (AN Ukrainskoj SSR, Kiev. Inst. Yadernykh Issledovanij). Phys. Lett., B; 58: No. 2, 139-141(1 Sep 1975).

Without any model assumptions it is shown for $^3$He(d,p)$^4$He reaction that there are no selection rules in channel spin, and that off diagonal tensor interaction, which couples deuteron and proton channels, is to be present to explain the experimental data at deuteron energies near 10 MeV. (NL)

## Nuclear Properties and Reactions, 6 ≤ A ≤ 19

*Refer also to abstracts 12766, 13015, 13467, 13470, 13471, 13473–13475, 13486, 13496, 13530, 13531, 13610, and 13713.*

**13483** (AECL-5226, pp 12) LOW SOLAR NEUTRINO FLUX: A SEARCH FOR A RESONANCE IN $^8$Be. McDonald, A. B.; Alexander, T. K.; Beene, J. R.; Tonner, P. D.; Mak, H. B. (Queen's Univ., Kingston, Ont.). Aug 1975.

In Physics Division progress report, April 1–June 30, 1975.

**13484** (ANL-75-75, pp 85-86) CROSS SECTIONS FOR NEUTRONS FROM $^6$Li+d REACTIONS AT LOW ENERGIES. Elwyn, A. J.; Holland, R. E.; Lynch, F. J.; Monahan, J. E.; Mooring, F. P. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13485** (ANL-75-75, pp 171-172) NON-NORMAL PARITY STATES IN LIGHT NUCLEI. Kurath, D.; Millener, D. J. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13486** (CEA-N-1791, pp 6-8) STUDY OF SOME EXCITED STATES OF $^{16}$O BY CORRELATION MEASUREMENTS. Avril, M.; Bianchi, L.; Lepareux, M.; Saunier, N.; Fotti, A.; Pappalardo, G.; Strazzeri, A. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Angular correlation measurements were used in the study of some $^{16}O$ highly excited levels, with 32 and 34 $^{6}Li$ ions. The results indicate spins of 6 and 7 for the levels at 21.8 and 20.9 MeV of $^{16}O$. (FR)

**13487** (CEA-N-1791, pp 10-12) $^{12}C(^{12}C,d)^{22}Na$ AND $^{12}C(^{12}C,\alpha)^{20}Ne$ BETWEEN 40 AND 60 MeV. Conjeaud, M.; Harar, S.; Lee, S. M.; Lepine, A.; Da Silveira, E.; Volant, C. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The excitation functions of the levels observed in the $^{12}C(^{12}C,d)^{22}Na$ and $^{12}C(^{12}C,\alpha)^{20}Ne$ reactions were studied at two angles in a wide incident energy range. Moreover the $^{20}Ne$(g.s) angular distribution was obtained at 52 MeV and shows strongly oscillating pattern. Preliminary results of the Hauser-Feshbach analysis of these data are presented. (FR)

**13488** (CEA-N-1791, pp 14-16) RESONANCE SCATTERING OF $^{16}O$ WITH $^{12}C$. Badawy, I.; Berthier, B.; Charles, P.; Fernandez, B.; Gastebois, J. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The excitation function of the elastic scattering of $^{16}O$ by $^{12}C$ has been measured from 15 MeV to 33.7 MeV on the last maximum of the angular distribution. Resonances are seen at 17.3 MeV, 19.7 MeV and 22.5 MeV and analyzed as shape resonance with an L-dependent absorption. (FR)

**13489** (CEA-N-1791, pp 17-18) STUDY OF $^{18}O(^{12}C,^{10}Be)^{20}Ne$ AND $^{28}Mg(^{12}C,^{10}Be)^{28}Si$ REACTIONS AT 46 MeV. Conjeaud, M.; Harar, S.; Lepine, A.; Da Silveira, E.; Volant, C. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

DWBA analysis of two proton transfer reactions leading to $^{20}Ne$ and $^{28}Si$ levels with the SETILL code and realistic wave functions do not fit relative cross sections. Results obtained from the LOLA code and (OS)2 proton cluster wave function derived from the Talmi-Moshinsky transform show that the microscopic wave function used strongly underestimate the (OS) proton pair component in $^{28}Si$ and in a less extend in $^{20}Ne$ ground state band members. (FR)

**13490** (CEA-N-1791, pp 83-85) STUDY OF THE PROTON INELASTIC SCATTERING ON $^{18}O$ AND $^{15}N$. Escudie, J. L.; Fabricci, E.; Lombard, R.; Pignanelli, M.; Resmini, F. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Inelastic scattering of protons on $^{18}O$ at eight energies ranging from 19 to 40 MeV was performed. A rotational analysis was made with the coupled channel code ECIS. The 1-(4.45 MeV) and 2-(5.52 MeV) levels are being analyzed with different intermediate states involving inelastic transitions, nucleon transfer or giant resonance. (FR)

**13491** (CEA-N-1791, pp 85-87) MACROSCOPIC CALCULATION OF THE OPTICAL POTENTIAL. Escudie, J. L.; Tarrats, A. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A new optical model code, using a folding model and exchange calculation, is in progress. First results are described, and the developments under way are shortly discussed. (FR)

**13492** (CEA-N-1791, pp 90-93) TWO STEP PROCESS IN THE $^{12}C(d,^{3}He)^{11}B$. Mayer, B. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A coupled channel calculation of both cross sections and analyzing powers was done for the $^{12}C(d,^{3}He)^{11}B$ reaction, at 45 MeV, leading to the first five states of $^{11}B$. This analysis includes two-step processes via the first $2^+$ state of $^{12}C$. It gives qualitative fits to the data for the $5/2^-$ and $7/2^-$ states in $^{11}B$ which are reached by pure two-step reaction, but it does not improve the fits for the other states. (FR)

**13493** (CEA-N-1791, pp 96-98) PRELIMINARY STUDY OF THE $(p,\pi^+)$ REACTION AT 600 MeV. Aslanides, E.; Bauer, T.; Bertini, R.; Beurtey, R.; Bimbot, L.; Boudart, A.; Brochard, F.; Bruge, G.; Chaumeaux, A.; Couvert, P. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Preliminary results of the $(p,\pi^+)$ reaction on $CD_2$, $^{6}Li$, and $^{7}Li$ were obtained at T(p) = 600 MeV using the spectrometer SPES I at Saturne. The $7/2^-$ state is the most strongly excited state in the $^{6}Li(p,\pi^+)^{7}Li$ reaction. This indicates that the two-step process (inelastic scattering plus neutron transfer) may be enhanced in comparison to the single stripping process, because of the more favorable total angular momentum transfer for the $7/2^-$ state as compared to the lower spin states. The T = 3/2 state at 11.25 MeV was not definitely identified in the $^{6}Li(p,\pi)^{7}Li$ reaction. (FR)

**13494** (CEA-N-1791, pp 140-141) MEASUREMENT OF THE PHOTOPRODUCTION CROSS SECTION FOR THE $\pi^+$ NEAR THE THRESHOLD ON $^{6}Li$ TARGETS. Audit, G.; de Botton, N.; Deutsch, J.; Faure, J. L.; Favart, B.; Preiels, R.; Schuhl, C.; Tamas, G.; Tzara, C.; Van Ostaeyen, B. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The ratio of positive pion photoproduction cross-sections on $^{6}Li$ and protons was measured near the threshold. The result is considerably lower than the existing theoretical predictions. (FR)

**13495** (CEA-N-1791, pp 146-148) ANALYSIS OF (e,e'p) EXPERIMENTS WITH $^{12}C$, $^{28}Si$, $^{40}Ca$, AND $^{58}Ni$. Bernheim, M.; Bussiere, A.; Gillebert, A.; Mougey, J.; Priou, M.; Royer, D.; Sick, I.; Wagner, G. J. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Experimental values for proton mean kinetic and removal energies were extracted from (e,e'p) results on $^{12}C$, $^{28}Si$, $^{40}Ca$, and $^{58}Ni$, in the framework of DWIA. Occupation numbers obtained generally agree with those of the shell model. (FR)

**13496** (CEA-N-1791, pp 160-162) MEASUREMENT OF THE MEAN POLARIZATION OF $^{12}B$ PRODUCED BY POLARIZED MUONS IN THE $\mu^- + {}^{12}C \rightarrow$ MUONIC NEUTRINO + $^{12}B$. Favart, D.; Grenacs, L.; Julien, J.; Lehmann, J.; Macq, P.; Meda, D.; Palfy, L.; Possoz, A.; Samour, C. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The average polarization of $^{12}B$ produced by the capture of polarized muons in $^{12}C$ was measured using recoil implantation techniques. The $J_{\mu 0}$ value is $0.43 \pm 0.10$. The ratio of the induced pseudoscalar and the axial-vector coupling constants is deduced to be $12 \pm 5$. (FR)

**13497** (CONF-741040-P1, pp 209-223) DIRECT CAPTURE STUDIES AS A TOOL IN NUCLEAR PHYSICS AND NUCLEAR ASTROPHYSICS. Rolfs, C. (Univ. Muenster, Ger.); Rodney, W. S. 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

Radiative capture reactions, in which the incident projectile is absorbed by the target nucleus followed by the emission of gamma radiation, form an important class of nuclear reactions, because they are of great value for the elemental synthesis in stars (nuclear astrophysics) as well as for the study of the properties of nuclear states (nuclear spectroscopy). Both branches of physics benefit therefore from a study of these reactions. The observed numbers (e.g. cross sections) are of direct interest to nuclear astrophysics, while the interpretation of these numbers with the help of models provide nuclear structure information. These features are especially apparent in studies of the radiative direct capture process. Studies of this process have been facilitated in recent years by the advent of large high resolution Ge (Li) detectors and improved techniques in providing and handling high beam currents from small accelerators. (auth)

**13498** (INIS-mf-1748) RESONANCE PROPERTIES IN THE INTERVAL $4.1 \leq Ep \leq 6.1$ MeV OF THE (p,p) AND $(\vec{p},p)$ REACTIONS ON $^{18}O$. Almanza S, R. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). 1974. 46p. (In Spanish). INIS.

Resonances in the reactions $^{18}O(p,p)^{18}O$ and $^{18}O(\vec{p},p)^{18}O$ were studied to determine the spin, parity, excitation energy, and isospin in the levels of $^{19}F$ and a comparison was made of these levels as analog isobaric states of $^{19}O$. The broad $3/2$ resonance predicted by the shell model at $E_x = 12.8$ MeV in $^{19}F$ was found, and in addition 12 other resonances were detected. Angular distributions of the differential cross section and polarization of the reactions were made at proton energies between 4.1 and 6.1 MeV at laboratory angles between 30 and $150^0$ for cross section measurements and 32.5 and $150^0$ for the polarization measurements. The elastic scattering was analyzed using the SCRAM program and resonance parameters were obtained for 13 levels in $^{19}F$.

**13499** (ITP-75-90R) CONCERNING THE CALCULATION OF THE MATRIX ELEMENTS OF THE KINETIC ENERGY OPERATOR IN THE GENERALIZED HYPERSPHERICAL FUNCTION METHOD FOR THE SIX-BODY PROBLEM. Smirnov, Yu. F.; Tolstoi, V. N. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 28p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

Using the projection operator method, a quasi-momentum basis in the irreducible representation space of the group SO(5) is constructed, the completeness of this basis is proved and the matrices of the generators and the operator combinations $\Sigma^2_{i=1} T^2_{ik}$, (k = 3,4,5) for the given group are found. The results obtained completely solve the problem of calculation of the matrix elements of the kinetic energy operator in the generalized hyperspherical function method for nuclei with the nucleon number A = 6. (auth)

**13500** (JINR-1-8131) KINEMATIC CHARACTERISTICS OF HYDROGEN AND HELIUM ISOTOPES FROM THE p + $^9$Be REACTION BY 660MeV PROTONS. Bogatin, V. I.; Lozhkin, O. V.; Grigor'ev, E. L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 14p. (In Russian). INIS.

4 refs.; 6 figs.; 1 table.

The kinematic characteristics of hydrogen and helium isotopes formed during interaction of 660-MeV protons with $^9$Be nuclei were measured by the $dE/d_x \times E$ method. Absolute differential cross sections for the formation of these isotopes at an angle of $\theta = 90^0_{lab}$ and the energy and angular distributions of $^3$He and $^4$He were obtained. (tr-auth)

**13501** (JINR-R-1-8252) STUDY ON THE $\mu^- + ^{12}C \rightarrow ^4He ^4He ^3Hn\nu$ REACTION. Vizireva, L.; Chernev, Kh. M.; Mirsalikhova, F.; Batusov, Yu. A.; Bunyatov, S. A.; Gulkanyan, G. R.; Sidorov, V. M.; Ehramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1974. 16p. (In Russian). INIS.

16 refs.; 5 figs.

The reaction $\mu^- + ^{12}C \rightarrow ^4He + ^4He + ^3H + n + \nu$ was studied experimentally. The upper limit of the probability ratio was determined, $W \lesssim 2 \times 10^{-2}$. Possible mechanisms of the reaction were examined. It was shown that with a probability of $(1.1 \pm 0.1) \times 10^{-2}$ per capture event it occurs according to a scheme predicted by a resonance mechanism of $\mu^-$ meson capture by a carbon nucleus. (tr-auth)

**13502** SYSTEM OF MULTIDIMENSIONAL ANALYSIS FOR STUDYING NUCLEAR REACTIONS ON THE IRF CYCLOTRON OF THE KazSSR ACADEMY OF SCIENCES. Burtebaev, N. T.; Vinogradov, A. A.; Vongai, A. D. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat.; No. 2, 65-68(1975). (In Russian)

A system was developed for identifying the products of nuclear reactions based on the telescope of ΔE-E counters, analyzer AI-4096-3M, and a programmer with light pencils, permitting effective division of three reaction channels simultaneously. The proton, deuteron, and triton spectra formed in the interaction of 50-5-MeV alpha particles with $^{12}$C nuclei were obtained. (tr-auth)

**13503** FOR AND AGAINST THE GARTENHAUS-SCHWARTZ TRANSFORMATION. Malecki, A.; Picchi, P. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 14: No. 11, 390-394(15 Nov 1975).

Some misunderstandings connected with the Gartenhaus-Schwarz transformation are clarified, formulating the shortcomings of the original derivation in another way. At the same time a particular result is avocated. As a numerical example, the charge form factor of oxygen 16 is calculated. (JFP)

**13504** LIGHT-FRAGMENT PRODUCTION IN p-NUCLEUS INTERACTIONS AT 600 MeV: ASTROPHYSICAL APPLICATION. Alard, J. P. (Clermont Univ., Aubier, France); Baldit, A.; Brun, R.; Costilhes, J. P.; Dhermain, J.; Fargeix, J.; Fraysse, L.; Pellet, J.; Roche, G.; Tamain, J. C.; Cordaillat, A.; Pasinetti, A. Nuovo Cim.; 30A: No. 2, 320-344(21 Nov 1975).

The energy spectra of light nuclides ($^1$H, $^2$H, $^3$H, $^3$He, $^4$He) produced in the interaction of 600 MeV protons on various targets (Be, C, Na, Al, Ca, Fe, Au) were measured at several laboratory angles (30, 45, 75, and 105°), by means of ΔE-E telescopes (semiconductor and scintillator detectors). The spectra are fitted with calculated curves derived both from a two-step model and a thermodynamical model of the p-nucleus interaction. Two ranges of nuclear temperature are found: the first one (about (20 to 30) MeV) describes the high energy part of the spectra, the second one (a few MeV) describes the low energy part (de-excitation of the residual nucleus). These fits are used for the integration over energies and angles, which allows the computation of the total cross sections and of the fragmentation probabilities. These probabilities are necessary for the study of $^2$H and $^3$He production in the propagation of galactic cosmic rays and their interaction with interstellar matter. It is found that the (CNO) contribution for the production of cosmic He nuclei is not negligible and must be added to the $^4$He contribution. The mean interstellar path length is about 4 g·cm$^{-2}$. The results obtained with Na and Ca targets should present a biophysical interest. (auth)

**13505** IMPORTANCE OF T = 0 EXCITATION MECHANISM IN (π, πN) REACTIONS ON $^{12}$C. Bressani, T. (Univ., Turin); Cannata, F. Lett. Nuovo Cim.; 14: No. 14, 523-525(6 Dec 1975).

A discussion is given of the cross section ratio which shows a deviation from 1 and seems to be critical with respect to the T = 0 excitation mechanism for (π, πN) reactions on carbon-12. (JFP)

**13506** HOW DOES THE ELASTIC SCATTERING OF $^{12}$C + $^{20}$Ne COMPARE WITH THAT OF $^{16}$O + $^{16}$O. Doubre, H.; Plagnol, E.; Roynette, J. C. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire); Loiseaux, J. M.; Martin, P.; de Saintignon, P. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires). J Phys. (Paris), Lett.; 36: No. 5, L.113-L.116(May 1975).

Excitation functions for 5 exit channels of the $^{12}$C + $^{20}$Ne system are given in the range 22-28MeV center of mass incident energy. An important structure is observed in the elastic scattering excitation functions taken at 90° and 130° (C. M.). This structure, which reminds one of the $^{16}$O + $^{16}$O case, is studied in terms of angular momentum matching. An angular distribution taken at 24.7 MeV (C. M.) is also presented. The direct channel absorption is shown to be intermediate between the $^{16}$O + $^{16}$O and $^{18}$O + $^{18}$O cases. (FR)

**13507** NUCLEAR PHOTOPRODUCTION OF RHO MESONS. Coddington, P.; Atkiss, M.; Brodbeck, T. J.; Locke, D. H.; Morris, J. V.; Newton, D.; Sloan, T. (Lancaster Univ. (UK)). Nucl. Phys., B; 95: No. 2, 249-268(1 Sep 1975).

Targets of Be, C, Al, Cu, Ag and Au were exposed to a tagged photon beam in the 2.75 to 4.35 GeV energy range and cross sections are presented for the reaction $\gamma A \rightarrow A\rho^0$. Optical spark chambers were used to examine charged particles and γ rays from the targets, so that the data are believed to be free from inelastic contamination. The results are analyzed both in terms of total cross sections for $(A\gamma \rightarrow \rho A)$, and in terms of forward differential cross sections for $(\gamma A \rightarrow \rho A)$. From the A dependence of these cross sections we determine the total ρ-nucleon cross section to be (22.5 ± 2.7) mb, and the absolute values of the cross sections determine the forward photoproduction cross section from a nucleon $(\gamma p \rightarrow \rho p) = (72.7 \pm 8)\ \mu b/GeV^2$. These values correspond to an assumed value $\alpha_{\rho N} = 0.2$ for the ratio of the real to imaginary part of the ρ nucleon forward scattering amplitude. The corresponding value of the photon-rho coupling constant $\gamma_\rho^2/4\pi = 0.65 \pm 0.16$. (auth)

**13508** ENERGY LEVELS OF LIGHT NUCLEI A = 11-12. Ajzenberg-Selove, F. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Nucl. Phys., A; 248: No. 1, 1-152(18 Aug 1975).

Compilation of energy levels of A = 11 and 12 nuclei with emphasis on material leading to information about the structure of the A = 11 and 12 systems is presented. (auth)

**13509** ISOSPIN VIOLATION IN α-INDUCED REACTIONS. Spuller, J.; Hasinoff, M. D.; Lim, S. T.; Measday, D. F.; Mulligan, T. J. (British Columbia Univ., Vancouver (Canada)). Nucl. Phys., A; 248: No. 2, 276-290(25 Aug 1975).

A study has been made of the reactions $^{12}C(\alpha,\alpha')^{12}C$ and $^{13}B$ $(\alpha,d)^{12}C$ which lead to the 12.71 MeV T = 0 and the 15.11 MeV T = 1 levels in $^{12}$C. Significant structure is observed in the yield curves of the reactions $^{12}C(\alpha,\alpha')^{12}C$ for both the isospin allowed and forbidden reactions up to the maximum available α-energy of 27 MeV; this structure is attributed to compound nucleus formation. No significant structure is observed in the reaction $^{10}B(\alpha,d)^{12}C$. (auth)

**13510** THE REACTIONS $^{18}O(\vec{p},p)^{18}O$ AND $^{18}O(\vec{p},p')O^*$ (1.98 MeV) FOR $E_p$ = 3.8-6.1 MeV. Almanza, R.; Murillo, G. (Instituto Nacional de Energia Nuclear, Mexico City). Nucl. Phys., A; 248: No. 2, 214-236(25 Aug 1975).

Angular distributions of cross sections and analyzing powers have been measured for $^{18}O(\vec{p},p)^{18}O$ and $^{18}O(\vec{p},p_1)^{18}O^*$(1.98 MeV) in 25 keV intervals for proton energies between 3.8 and 6.1 MeV. A phase-shift analysis of the elastic scattering data was carried out, yielding resonance parameters for 16 levels in $^{19}$F in the excitation energy region 11.6-13.8 MeV. The results generally are in good agreement with previous work. On the basis of spin, parity, excitation energy and a comparison of reduced proton widths with reduced neutron widths of levels in $^{19}$O, an assignment of T = 3/2 could be made to at least five of the levels,

including the analog of the broad $3/2^+$ level in $^{19}O$ at 5.45 MeV. A Legendre-polynomial analysis of the inelastic scattering data suggests that the cross section for proton energies between 5.0 and 5.5 MeV is dominated by the broad $3/2^+$ resonance at $E_p$ = 5.15 MeV. (auth)

**13511** THE NEUTRON DECAY OF THE RESONANCE IN THE $^{12}C^+$ $^{16}O$ SYSTEM AT $E_{cm}$ = 19.7 MeV. Sperr, P.; Evers, D.; Harasim, A.; Assmann, W.; Konrad, P.; Rudolph, K.; Denhoefer, G.; Ley, C. (Muenchen Univ. (F. R. Germany). Sektion Physik). Phys. Lett., B; 57: No. 5, 438-440(4 Aug 1975).

The reaction $^{12}C(^{16}O, n)^{27}Si$ has been studied at nine incident energies in the range of $E_{cm}$ = 19.39 to 22.6 MeV. At the known 19.7 MeV resonance two states at 15.37 and 17.04 MeV in $^{27}Si$, probably with high spins, were strongly excited. The width of the resonance in these states is consistent with the known width of about 400 keV (cm). No resonating states were found above this resonance. (auth)

**13512** APPLICATION OF THE EXTENDED BARSHAY-TEMMER THEOREM TO HEAVY-ION REACTIONS. Voit, H.; Hamm, M.; Nair, K. G.; Towsley, C.; Bacher, A. D.; Nagatani, K. (Texas Agricultural and Mechanical Univ., College Station (USA). Cyclotron Inst.); Siller, F. (Erlangen-Nuernberg Univ., Erlangen (F. R. Germany). Physikalisches Inst.). Phys. Lett., B; 58: No. 2, 152-154(1 Sep 1975).

The reactions $^{10}B + ^{12}C$, $^{14}N + ^{16}O$ leading to various final states in the isobaric mass systems 11, 13, and 15, respectively, have been investigated experimentally. These measurements provide a number of applications for the extended Barshay-Temmer theorem. (NL)

**13513** HIGH RESOLUTION INELASTIC ELECTRON SCATTERING AND RADIATION WIDTHS OF LEVELS IN $^{16}O$. Miska, H.; Graef, H. D.; Richter, A.; Schneider, R.; Schuell, D.; Spamer, E.; Theissen, H.; Titze, O. (Technische Univ. Darmstadt (F. R. Germany). Inst. fuer Kernphysik); Walcher, T. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F.R. Germany)). Phys. Lett., B; 58: No. 2, 155-158(1 Sep 1975).

Inelastic electron scattering with high energy resolution (FWHM = 30 KeV) has been used to study the states at 6.05($0^+$), 6.13($3^-$) and 6.92($2^+$) MeV excitation energy in $^{16}O$ for momentum transfers $q = 0.22 - 0.49$ fm$^{-1}$. The experiment yields a new determination of reduced transition probabilities and radiative widths for ground-state transitions. (NL)

**13514** COHERENT PROTON DISSOCIATION ON NUCLEAR TARGETS. Gobbi, B.; Rosen, J. L.; Scott, H. A. (Northwestern Univ., Evanston, Ill. (USA)); Shapiro, S. L.; Strawczynski, L. (Rochester Univ., N. Y. (USA)); Edelstein, R. M.; Makuchowski, E. J.; Meltzer, C. M.; Miller, E. L. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA)). Phys. Lett., B; 58: No. 2, 219-222(1 Sep 1975).

Measurements have been made of the coherent dissociation process $p + A \rightarrow p\pi^0 + A$ with 22.7 GeV/c protons incident on nuclear targets. Coulomb dissociation producing primarily $\Delta^+$, and diffractive dissociation are observed. The $\Delta^+$ production cross sections are in excellent agreement with the predictions from $\Delta^+$ photoproduction. Some disagreement with published neutron dissociation data recorded at comparable energies is noted. (NL)

**13515** ANGULAR DISTRIBUTIONS IN THE RADIATIVE CAPTURE OF 14 MeV NEUTRONS. Drake, D. M. (Los Alamos Scientific Labs., NM); Arthur, E. D.; Halpern, I. pp 227-232 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Relative yields of capture photons have been observed at 55, 90, and 125° for four nuclei in bombardments with 14 MeV neutrons. The yields from $^{10}B$, $^{29}Si$, and $^{40}Ca$ show little fore-aft anisotropy in contrast with those observed in proton capture, which generally peak forward. Neutron capture in $^{12}C$ is found to peak backward, suggesting the existence of a broad E2 resonance below the GDR. (auth)

**13516** SHELL MODEL DIAGONALIZATIONS IN AN EXPANDED SPACE. Rowe, D. J. (Univ. of Toronto). pp 250-269 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

The expanded shell model approach to effective interactions is discussed and applied to sd shell configurations outside of an $^{16}O$ core. A correspondence is made between so-called exact shell model diagonalization and the folded-linked-cluster expansion. Some calculated results are shown for low lying spectra of mass 18 nuclei along with matrix elements of the two-body effective interaction. Comments are offered on the realism of expanded shell model calculations. (9 figures, 3 tables) (SDF)

**13517** GAMMA-RAY PRODUCTION CROSS SECTIONS FOR CARBON AND NITROGEN FROM THRESHOLD TO 20.7 MeV. Rogers, V. C.; Orphan, V. J.; Hoot, C. G.; Verbinski, V. V. (Intelcom Rad Tech., San Diego, CA). Nucl. Sci. Eng.; 58: No. 3, 298-313(Nov 1975).

Gamma-ray production cross sections were measured for the $^{12}C$(n,x gamma) and $^{14}N$(n,x gamma) reactions from 2.0- to 20.7-MeV neutron energy using the Intelcom Rad Tech Linac source. The carbon cross sections are presented for both high neutron resolution and ten broad neutron groups spanning the energy range. Cross sections for the discrete gamma-ray peaks from nitrogen are presented in 12 broad neutron groups, as are the "discrete plus continuum" cross sections obtained by unfolding the gamma-ray spectra. The measured cross sections generally agree with the evaluations and with previous measurements. (3 tables, 16 figures) (auth)

# Nuclear Properties and Reactions, 20 ≤ A ≤ 38

*Refer also to abstracts 12766, 13015, 13474, 13487, 13489, 13495, 13504, 13506, 13507, 13511, 13514, 13515, 13541, 13546, 13568, 13569, 13591, and 13707.*

**13518** (ANL-75-75, pp 70, 72, 73) DECAY OF THE t/sub ½/ EQUALS 22 mu s ISOMERIC STATE OF $^{38}K$. Yates, S. W.; Lynch, F. J.; Holland, R. E.; Ahmad, I.; Friedman, A. M. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13519** (CEA-N-1791, pp 20-22) STUDY OF CONTINUUM STATES IN $^{24}Mg$ BY $^{20}Ne(\alpha,\alpha')$ AND $^{23}Na(p,\alpha)$ REACTIONS. Ballini, R.; Cindro, N.; Fouan, J. P.; Kalbach, C.; Lepareux, M.; Saunier, N. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Excitation functions were measured for the $^{20}Ne(\alpha,\alpha')^{20}Ne$ and $^{23}Na(p,\alpha)^{20}Ne$ reactions in the energy ranges corresponding to, respectively, 17.85 – 21.67 and 19.35 – 20.65 MeV of excitation in $^{24}Mg$, that is in the region of the sub-Coulomb resonances in $^{24}Mg$ observed in the $^{12}C + ^{12}C$ reactions. The energies of possible quasibound states in $^{24}Mg$ responsible for the deviations from the average trends in the above excitation functions were determined by statistical analysis and they were compared to the energies of known sub-Coulomb resonances in $^{24}Mg$. The comparison speaks in favor of interpreting the simple structures associated with the resonances as $\alpha$-like configurations in the $^{24}Mg$ continuum. (FR)

**13520** (CEA-N-1791, pp 46-51) GAMMA SPECTROMETRY WITH HIGH ENERGY PROTON. Alard, J. P.; Artun, O.; Baldit, A.; Cassagnou, Y.; Costilhes, J. P.; Fargeix, J.; Legrain, R.; Lisbona, N.; Roche, G.; Roussel, L. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A $^{40}Ca$ target was bombarded with 230, 325, 600, and 960 MeV protons. Gamma rays were observed in coincidence with the beam. A large number of lines on the $\gamma$ energy spectra correspond to de-excitation of the first levels of A-4n nuclei, A being the target mass. Relative yields allow comparison of one nucleon, two nucleons, alpha and multiple alpha removal from the target to inelastic scattering-comparison is also given with recent data from experiments performed with in-flight pions and stopped pions. (FR)

**13521** (CEA-N-1791, pp 100-101) pp' INELASTIC SCATTERING AT 1 GeV ON $^{58}Ni$. Bertini, R.; Beurtey, F.; Brochard, F., Bruge, G.; Catz, H.; Chaumeaux, A.; Durand, J. M.; Faivre, J. C.; Fontaine, J. M.; Garreta, D. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Previous experiments on inelastic scattering of 1.04 GeV protons were reanalyzed. The angular distribution corresponding to ten levels between 3 MeV and 8 MeV were obtained for center-of-mass angles between 5° and 18°. (FR)

**13522** (INIS-mf-1803) INVESTIGATION OF $^{30,32}P$ AND $^{34}Cl$ LEVELS WITH DIRECT REACTIONS. van Gasteren, J. J. M. (Rijksuniversiteit Utrecht (Netherlands)). 1974. 45p. INIS.

See also INIS Atomindex 090610, Nucl. Phys. A231(1974)411, A231(1974)425.

The reactions $^{31}P(d,p)^{32}P$, $^{35}Cl(\tau,\alpha)^{34}Cl$ and $^{31}P(\tau,\alpha)^{30}P$ have been studied. Angular distributions were measured, and a DWBA analysis yielded $l_n$ values and spectroscopic factors. The energy levels of $^{32}P$, $^{34}Cl$, and $^{30}P$ were found. The results were compared with many-particle shell-model calculations. (INIS)

**13523** (INIS-mf-1818) STUDIES ON THE NUCLEI $^{33}S$, $^{33}Cl$, AND $^{35}S$. van der Mark, T. W. (Rijksuniversiteit Groningen (Netherlands)). 10 Mar 1975. 94p. INIS.

Thesis.

In order to study lower negative-parity states of $^{33}S$, $^{33}Cl$, and $^{35}S$, level schemes were investigated by gamma spectroscopy for the reaction $^{32}S(d,p\gamma)^{33}S$ at 4.72 and 4.25 MeV, $^{34}S(d,p\gamma)^{35}S$ at 4.72 MeV deuteron energy and $^{32}S(p,\gamma)^{33}Cl$ at 1.892 MeV proton resonance for which $\Gamma\gamma$ was determined. Information about the 8.209 MeV ground state gamma transition following the reaction $^{34}S(p,\gamma)^{35}Cl$ at the 1.891 MeV proton resonance was obtained at the same time. The multipole mixing ratio $\delta$ was derived from the measured angular distribution of the gamma rays. Using the branching ratio as seen from the gamma spectra measured by Ge(Li) detectors, spins and parities could be deduced. By analyzing the alpha spectrum from the $^{37}Cl(d,\alpha\gamma)^{35}S$ reaction at 4.25 MeV some levels of $^{35}S$ could be established. Shell model calculations using the isospin formalism and a Modified Surface Delta Interaction were done for $^{33}S$, $^{33}Cl$, $^{35}S$, and $^{35}Cl$. Two models were used both assuming $^{28}Si$ as inert core with $(2s_{\frac{1}{2}})^m(1d_{\frac{3}{2}})^n(1f_{\frac{7}{2}})$ and $(2s_{\frac{1}{2}})^m(1d_{\frac{3}{2}})^n(2p_{\frac{3}{2}})$ configurations for the remaining particles where $2 \leq m \leq 4$ for model A and $0 \leq m \leq 4$ for model B. Levels and multipole transition rates are calculated and compared with experiment. Better agreement was obtained than in earlier calculations. Formulae and some values for multipole reduced matrix elements are given. (auth)

**13524** MECHANISM OF THE RADIATIVE NEUTRON CAPTURE IN HEAVIER NUCLEI WITH CLOSED NEUTRON SHELLS AT THE EXCITATION ENERGIES OF DIPOLE GIANT RESONANCES. Potokar, M.; Likar, A.; Cvelbar, F. (Univ. of Ljubljana, Yugoslavia). pp 145-150 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The present experimental data on fast neutron radiative capture in $^{208}Pb$, $^{138}Ba$, $^{88}Sr$, and $^{40}Ca$ is sufficient to show that the direct-semidirect model does not account for the capture dynamics satisfactorily. However, the recently proposed refined direct-semidirect model, which involves the complex coupling interaction between the incident nucleon and the target nucleus reproduces the experimental results well. This may be an indication that some more complex configurations cannot be ignored when describing the reaction mechanism. (auth)

**13525** SINGLE PARTICLE STATES IN NEUTRON CAPTURE. Bird, J. R. (Australian Atomic Energy Commission, Lucas Heights); Hille, F. pp 160-164 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The strongest transitions in thermal and resonance neutron capture for nuclei with $20 < A < 140$ show evidence for the position of single-neutron states. Results for (n, $\gamma$) and (d, p) are compared, and the resulting systematic trends are used to predict results for nuclei which have not yet been studied. (auth)

**13526** ROLE OF COLLECTIVE E1 $\gamma$ TRANSITIONS IN CAPTURE STATE DE-EXCITATION IN THE (n, $\gamma$) REACTION. Martsynkevich, B. A.; Nelaeva, V. I.; Rudak, E. A. (Inst. of Physics, Minsk). pp 179-180 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The role of collective E1 $\gamma$-transitions in capture state decay in the slow-neutron (n, $\gamma$) reaction on even spherical nuclei with $A \simeq 50 - 80$ and $A \simeq 140$ is investigated. It is shown that the collective E1 $\gamma$-transitions can play an appreciable part in the capture state decay with spin $\frac{1}{2}^+$ to final p-levels at the excitation energy $E = \hbar w(2^+)/2\pi + \hbar w(3^-)/2\pi$. The role of the collective $\gamma$-transitions rises with increasing mass number. (auth)

**13527** $\gamma$ RAYS FROM FAST NEUTRON CAPTURE IN SILICON AND SULFUR. Nilsson, L. (Tandem Accelerator Lab., Uppsala); Lindholm, A.; Bergqvist, I. pp 222-226 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

$\gamma$-ray spectra from neutron capture in natural samples of silicon and sulfur have been measured at incident neutron energies between 4.7 and 10.9 MeV as well as at 15 MeV. A large NaI(Tl) scintillator was used as $\gamma$-ray detector and the time-of-flight technique was employed to reject undesirable background. The experimental results are compared with theoretical predictions of the semi-direct model. (auth)

**13528** RADIATIVE CAPTURE OF FAST NEUTRONS BY NUCLEI FROM Al TO La. Rigaud, F. (CENBG, Gradignan, France); Desthuilliers, M. G.; Petit, G. Y.; Irigaray, J. L.; Longo, G.; Saporetti, F. pp 233-238 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The radiative capture cross-section of 14.6 MeV neutrons by nuclei from Al to La has been measured by means of the activation method. The effect of secondary neutrons on the observed capture cross-section has been accurately taken into account by systematically varying the sample thickness and by minimizing the influence of the tritium target heads and of the target backing materials. The results of the present improved activation measurements indicate a value of about $1.0 \pm 0.5$ mb for the (n, $\gamma$) cross-sections in nuclei throughout the periodic table, which is in satisfactory agreement both with the results of spectrum method measurements and with the predictions of direct and semi-direct models. (auth)

**13529** $^7Be$ PRODUCTION IN IRON AND SILICON IRRADIATED WITH 0.6 AND 24 GeV PROTONS. Regnier, S.; Paillard, P.; Simonoff, G. (Bordeaux-1 Univ., 33-Gradignan (France). Centre d'Etudes Nucleaires). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 16, 513-514(28 Apr 1975). (In French)

The rates for $^7Be$ production in iron and silicon targets irradiated with 0.6 and 24 GeV protons were measured. The cross sections for the formation of $^7Be$ are: $5.8 \pm 2.0$ and $10.5 \pm 3$ mb in silicon; $1.8 \pm 0.6$ and $10.2 \pm 1.$ mb in iron at 0.6 and 24 GeV respectively. (FR)

**13530** RECOIL DISTANCE MEASUREMENTS OF g-FACTORS FOR $^{24}Mg(2_1^+)$ AND $^{20}Ne(2_1^+)$. Horstman, R. E.; Eberhardt, J. L.; Doubt, H. A.; Oteen, C. M. E.; van Middelkoop, G. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). Nucl. Phys., A; 248: No. 2, 291-316(25 Aug 1975).

Time-differential recoil-into-vacuum measurements have been performed with a plunger on the first-excited $2^+$ states of $^{24}Mg$ and $^{20}Ne$. The states were populated by the reactions $^{12}C(^{16}O,\alpha)^{24}Mg$ and $^{12}C(^{12}C,\alpha)^{20}Ne$. The measured anisotropy of the $\alpha$-$\gamma$ angular correlation was greatly increased by means of a vertical slit on the annular particle detector. g-factor values = $0.51 \pm 0.02$ and $0.54 \pm 0.04$ and have been deduced for $^{24}Mg$ and $^{20}Ne$ respectively. The mean lives of these states have been determined as $\tau = 2.09 \pm 0.13$ ps and $0.8 \pm 0.2$ ps, respectively. Various theoretical calculations are discussed and compared with the measured g-factors. The analysis of the measurement also yields for the populations of electronic stated contributing to the hyperfine interaction. For $^{20}Ne$ the populations of the different electronic configurations are compared with the results of a separate time-integral measurement, in which the correlations were measured for each ionic state separately. Large fractions of two-electron excited states are found to contribute. (auth)

**13531** MASS MEASUREMENTS OF $^{19}Na$ AND $^{23}Al$ USING THE ($^3He$,$^8Li$) REACTION. Benenson, W.; Guichard, A.; Kashy, E.; Mueller, D.; Nann, H.; Robinson, L. W. (Michigan State Univ., East Lansing (USA). Cyclotron Lab.). Phys. Lett., B; 58: No. 1, 46-48(18 Aug 1975).

The mass excesses of $^{19}Na$ and $^{23}Al$ have been measured with the ($^3He$,$^8Li$) reaction. The values obtained are 12928 ± 12 keV and 6767 ± 25 keV, respectively. The first excited state of $^{19}Na$, observed to lie at 120 ± 10 keV, completes a mass quartet which agrees with a quadratic isobaric mass equation. (NL)

**13532** INVESTIGATION OF THE $^{24}Mg(d,p)^{25}Mg$ REACTION. Meurders, F.; de Korte, G. (Rijksuniversiteit Utrecht (Netherlands). Fysisch Lab.). Nucl. Phys., A; 249: No. 2, 205-214 (15 Sep 1975).

Proton angular distributions from the $^{24}Mg(d,p)^{25}Mg$ reaction at $E_d = 12.0$ MeV have been measured with a split-pole magnetic spectrograph for $E_x < 6$ MeV at an average resolution (FWHM)

of 7 keV. New $l_n$ values have been determined for three levels. A DWBA analysis yielded spectroscopic factors for 17 levels. A comparison has been made with shell-model and collective model results. (NL)

**13533** CROSS-SECTION MEASUREMENT OF (n,p) REACTIONS FOR $^{27}$Al, $^{46\ 47\ 48}$Ti, $^{54\ 56}$Fe, $^{58}$Ni, $^{59}$Co, AND $^{64}$Zn FROM NEAR THRESHOLD TO 10 MeV. Smith, D. L.; Meadows, J. W. (Argonne National Lab., IL). Nucl. Sci. Eng.; 58: No. 3, 314-320 (Nov 1975).

Cross sections for the $^{27}$Al(n,p)$^{27}$Mg, $^{46\ 47\ 48}$Ti(n,p)$^{46\ 47\ 48}$Sc, $^{54\ 56}$Fe(n,p)$^{54\ 56}$Mn, $^{58}$Ni(n,p)$^{58}$Co, $^{59}$Co(n,p)$^{59}$Fe, and $^{64}$Zn(n,p)$^{64}$Cu reactions were measured by activation methods for neutron energies from near threshold to 10 MeV. The cross sections were determined relative to $^{235}$U and $^{238}$U fission cross sections. The data are compared with values from the literature. (auth)

# Nuclear Properties and Reactions, 39 ≤ A ≤ 58

*Refer also to abstracts 12130, 13474, 13495, 13504, 13515, 13525, 13526, 13528, 13529, 13533, 13568, 13569, 13610, and 13639.*

**13534** (ANL-75-75, pp 18-19) STUDY OF SINGLE-NUCLEON TRANSFER SYSTEMATICS IN HEAVY-ION-INDUCED REACTIONS. Eisen, Y.; Fortune, H. T.; Henning, W.; Kovar, D. G.; Vigdor, S. E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13535** (ANL-75-75, pp 20, 22, 23) STUDIES OF $^{16}$O-INDUCED "alpha-PARTICLE" TRANSFER ON CALCIUM ISOTOPES. Eisen, Y.; Erskine, J. R.; Fortune, H. T.; Greenwood, L. R.; Henning, W.; Kovar, D. G.; Vigdor, S. E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13536** (ANL-75-75, pp 22, 24-26) STUDIES OF TWO-NUCLEON TRANSFER REACTIONS IN THE SCATTERING OF $^{16}$O FROM $^{48}$Ca AND $^{42}$Ca. Eisen, Y.; Fortune, H. T.; Henning, W.; Kovar, D. G.; Vigdor, S. E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13537** (ANL-75-75, pp 27-29) L DEPENDENCE IN ANGULAR DISTRIBUTIONS OF THE TWO-PROTON TRANSFER REACTION $^{48}$Ca($^{16}$O, $^{14}$C)$^{50}$Ti. Erskine, J. R.; Henning, W.; Kovar, D. G.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13538** (ANL-75-75, pp 35-36) OPTICAL POTENTIAL IN HEAVY-ION TRANSFER REACTIONS. Eisen, Y.; Erskine, J. R.; Henning, W.; Kovar, D. G.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13539** (ANL-75-75, pp 37, 39-40) CROSS SECTIONS FOR REACTIONS INDUCED BY $^{16}$O ON Ca ISOTOPES. Eisen, Y.; Fortune, H. T.; Henning, W.; Kovar, D. G.; Vigdor, S. E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13540** (CEA-N-1791, pp 19-20) PRELIMINARY STUDY OF THE $^{28}$Si, $^{29}$Si($^{16}$O,$\alpha$)$^{40}$Ca, $^{41}$Ca REACTIONS. Badawy, I.; Bethier, B.; Charles, P.; Fernandez, B.; Gastebois, J.; Laurent, P.; Schapira, J. P. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The reactions $^{28}$Si,$^{29}$Si($^{16}$O,$\alpha$)$^{40}$Ca,$^{41}$Ca were investigated as means of studying high spin states of $^{40}$Ca, $^{41}$Ca. Preliminary results show a small yield for $^{40}$Ca and a nonmeasurable one for $^{41}$Ca. (FR)

**13541** (CEA-N-1791, pp 32-36) HIGH SPIN LEVELS IN THE f-p SHELL. Ballini, R.; Bendjaballah, N.; Delaunay, B.; Delaunay, J.; Fouan, J. P.; Kim, H. J.; Pichevar, M. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A program for the research of high spin states in the f-p shell was initiated. The $\gamma$-$\gamma$ coincidences were detected with two Ge(Li) detectors at 0° and 90° to establish the scheme and determine the ratio R of the intensities of two $\gamma$ cascades detected in coincidence. The $\gamma$ angular distributions of the interesting transitions obtained were analyzed to have the Legendre polynomials coefficient $A_2$, $A_4$. With the observables $A_2$, $A_4$, R it is possible to make an unambiguous spin assignment and to determine the mixing ratio without the usual assumption of a gaussian form for the population of the magnetic substates. A code is on development to make easy this analysis. Information was obtained on $^{59}$Ni, $^{60}$Ni, $^{56}$Fe, $^{56}$Co, and $^{40}$Ca from the reactions $^{50}$Cr + $^{12}$C at 48 MeV for $^{59}$Ni, $^{56}$Fe, and $^{56}$Co, the reaction $^{50}$Cr + $^{12}$C at 33 MeV for $^{60}$Ni, and $^{28}$Si + $^{14}$N at 40 MeV for $^{40}$Ca. (FR)

**13542** (CEA-N-1791, pp 71-79) QUASI-ELASTIC (p,n) REACTIONS INDUCED BY 22.8 MeV POLARIZED PROTONS ON $^{56}$Fe AND $^{117}$Sn NUCLEI. Gosset, J.; Escudie, J. L.; Mayer, B. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The angular distribution of the analyzing power in the reactions $^{56}$Fe(p,n)$^{56}$Co and $^{117}$Sn(p,n)$^{117}$Sb leading to the analog state of the target nuclei were measured. A macroscopic analysis using the asymmetry dependence of the optical-model global analysis of Becchetti and Greenless does not give a good account for the data. A microscopic analysis, including the (p,n), (d,n) two-step process, is in progress. (FR)

**13543** (CEA-N-1791, pp 80-81) $\alpha$ PARTICLE SCATTERING ON NICKEL ISOTOPES. Boudard, A.; Bruge, G.; Chaumeaux, A.; Couvert, P. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Few energy spectra were taken for the $^{58}$Ni, $^{60}$Ni($\alpha$,$\alpha'$)$^{58}$Ni, $^{60}$Ni reactions at 30 MeV, using a 180° magnetic spectrometer facility associated with solid state 10 cm position sensitive counters. An energy resolution of 15-19 KeV was achieved. The $^{60}$Ni structure appears to be much more complicated than for $^{58}$Ni. For the high lying states in $^{58}$Ni this experiment confirms previous results and interpretation of these states, especially the 6.024 MeV level, is still valid. (FR)

**13544** (CEA-N-1791, pp 94) 1.04 GeV PROTON SCATTERING ON $^{40}$Ca, $^{42}$Ca, $^{44}$Ca, $^{48}$Ca, AND $^{49}$Ti. Alkhazov, G.; Bauer, T.; Beurtey, R.; Boudard, A.; Bruge, G.; Chaumeaux, A.; Couvert, P.; Gvijanovich, G.; Duhm, H.; Fontaine, J. M. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The relative differential cross sections for elastic scattering of 1.04 GeV protons from $^{40}$Ca, $^{42}$Ca, $^{44}$Ca, $^{48}$Ca, and $^{49}$Ti were measured in the angular range of 4–19° in the laboratory. Preliminary results are shown. (FR)

**13545** (CEA-N-1791, pp 142-144) ELASTIC SCATTERING OF ELECTRONS ON $^{58}$Ni AT HIGH MOMENTUM TRANSFER. Bellicard, J. B.; Bernheim, M.; Bussiere de Nercy, A.; Frois, B.; Gillebert, A.; Huet, M.; Sick, L.; Leconte, P.; Mougey, J.; Phan Xuan Ho. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

An elastic electron scattering experiment on $^{58}$Ni was carried out at very high momentum transfer in order to determine the fine structure of the nuclear charge density $\rho$(r) with small error bars by an independent model data analysis. Preliminary results obtained from a phenomenological analysis show a weak structure in reasonable agreement with Hartree-Fock calculation. (FR)

**13546** REVIEW OF CORRELATION DATA: DEPARTURES FROM THE STATISTICAL MODEL. Mughabghab, S. F. (Brookhaven National Lab., Upton, NY). pp 53-79 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Gamma-ray spectra due to radiative neutron capture in the thermal and resonance region are examined for nonstatistical effects. The data appear to be consistent with the interpretation that generally direct hard sphere capture dominates in the thermal region for A less than or equal to 46 while valence capture plays a significant and sometimes dominant role in the vicinity of the peaks of the 2p, 3s and 3p single particle giant resonances. Additional evidence of valence capture is provided by data on $^{24}$Mg, $^{36}$Ar, and $^{54}$Fe. On the other hand, correlations between partial radiative widths and either the (d,p) spectroscopic factors or the reduced neutron widths are reported. Since the magnitude of the valence neutron contribution cannot account for these observations, the doorway state picture is invoked. 18 figures, 50 references. (auth)

**13547** INVESTIGATION OF THE REACTION $^{50}$Cr(n, $\gamma$)$^{51}$Cr. Kopecky, J. (FOM–RCN Nuclear Structure Group, Petten, Netherlands). pp 155-157 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

γ rays following thermal-neutron capture in a $^{50}$Cr-enriched target have been measured with a Ge(Li) detector. A total of 71 γ-rays has been ascribed to the studied reaction, with 60 of them placed into a decay scheme. For 25 levels the excitation energy has been determined with 0.12–0.7 keV error. The reaction Q-value is (9261.7 ± 0.7) keV. Measured γ-intensities for strong El-primary transitions are in agreement with the valency neutron capture predictions. (auth)

**13548** ENHANCED TRANSITIONS IN THE (n,gamma) REACTION TO COLLECTIVE 3$^-$ STATES IN NUCLEI NEAR CLOSED NEUTRON SHELLS. Kane, W. R. (Brookhaven National Lab., Upton, NY). pp 181-185 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Exceptionally strong primary transitions occur in the (n,gamma) reaction to collective octupole states in even-even nuclei near closed neutron shells. The possible relevance of this effect to direct capture and doorway states in these nuclei is discussed. (auth)

**13549** FAST NEUTRON CAPTURE γ RAY SPECTRA IN Fe. Allen, B. J. (Australian Atomic Energy Commission, Lucas Heights); Kenny, M. J.; Barrett, R. F.; Bray, K. H. pp 217-221 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

γ-ray spectra for neutron capture in iron have been measured for neutron energies up to 1 MeV. Analysis of the spectra in terms of both the statistical and valence capture models cannot adequately account for the intense high-energy component observed at all neutron energies. (auth)

**13550** 1$^+$ STATES IN $^{58}$Ge. Raman, S.; Slaughter, G. G.; Good, W. M.; Harvey, J. A.; McGrory, J. B.; Larson, D. (Oak Ridge National Lab., TN). pp 277-279 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Levels in $^{58}$Fe have been investigated via the $^{57}$Fe(n,gamma) reaction with neutrons below 30 keV. Results for the 3.97 keV, 0$^-$ resonance, when combined with previously known circular polarization results, lead to twelve 1$^+$ states in $^{58}$Fe below 5.3 MeV. Good agreement is found between the experimental level spectrum and a theoretical one based on the shell model. (auth)

**13551** HIGH ENERGY γ-RAY TRANSITIONS OF $^{58}$Ni AND $^{60}$Ni RESONANCES. Beer, H.; Spencer, R. R.; Kappeler, F. (Kernforschungszentrum, Karlsruhe, Ger.). pp 285-290 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

High energy γ-ray transitions to low lying states in $^{59}$Ni and $^{61}$Ni following neutron capture have been investigated for individual resonances in the energy region from 7 to 70 keV at the Karlsruhe 3 MV pulsed Van de Graaff by means of a 50 cc Ge(Li) detector. As a result partial radiation widths for 10 transitions were determined. For the $^{60}$Ni 12.5 keV s-wave resonance very strong transitions to the $^{61}$Ni ground state and ½$^-$ state have been found. The $^{59}$Ni 47.8 keV resonance was found to have spin ³/₂. (auth)

**13552** MECHANISM OF RADIATIVE CAPTURE OF THERMAL NEUTRONS BY EVEN SPHERICAL NUCLEI WITH A APPROX. = 50–80 AND A APPROX. = 140. Knat'ko, V. A.; Rudak, E. A. (Inst. of Physics, Minsk). pp 292-293 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The contributions of the simplest configurations to the γ decay of the capture state from the thermal-neutron (n, γ) reaction on the even spherical nuclei with A ≈ 50–80 and A ≈ 140 are estimated. (auth)

**13553** PROTON RESONANCE CAPTURE STUDIES. Garg, J. B. (State Univ. of New York, Albany). pp 401-427 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The present summary of proton resonance capture studies emphasizes the similarities with neutron capture studies. The importance of the doorway concept and of correlations between channels has been emphasized. The scope and future implications of such investigations are stressed. (17 figures, 38 references) (auth)

**13554** THRESHOLD PHOTONEUTRON SPECTRA. Jackson, H. E. (Argonne National Lab., IL). pp 437-458 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Photoneutron spectra in the resolved resonance region near threshold are reviewed as a tool for the study of the neutron capture reaction mechanism. Recent measurements of the photodisintegration of the deuteron near threshold suggest discrepancies with the elementary model of the reaction. Data for nuclei in the mass region A approximately 50 to 60 contain partial width correlations and non-resonant reaction components characteristic of channel capture. Other nuclear structure effects in the form of intermediate structure and partial width correlations for heavier nuclei are also discussed. Photon strength functions for E1 and M1 radiation resulting from measurement of threshold photoneutron spectra are compared with data from other sources and theoretical predictions. Intense p-wave photoneutron emission by the Pb isotopes indicates the presence of a magnetic dipole giant resonance whose integrated strength is close to the theoretical limit. 17 figures, 1 table. (auth)

**13555** NUCLEAR PHOTOEXCITATION. Moreh, R. (Nuclear Research Centre–Negev, Beersheva, Israel). pp 459-470 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The various methods of nuclear photoexcitation using neutron capture γ-rays are reviewed. Each of the methods is illustrated by one contribution. (14 figures) (auth)

**13556** THERMAL NEUTRON CAPTURE IN $^{58}$Ni. Hofmeyr, C. (Atomic Energy Board, Pelindaba, South Africa). pp 537-543 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd internationsl symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

In a thermal neutron capture γ-ray study sixteen excited states were observed in simple cascades from the capture state to the ground state. Of the 139 observed γ-rays 82 could be placed in the proposed decay scheme. (3 tables) (auth)

**13557** $^{46}$Ti(n,γ) CIRCULAR POLARIZATION MEASUREMENT. Ratynski, W. (IBJ, Swierk, Poland); Kopecky, J. pp 605-608 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The circular polarization of γ-rays from the capture of polarized thermal neutrons in an isotopically enriched target of $^{46}$Ti has been measured. The analysis of 7 primary transitions resulted in 6 unambigous spin assignments. Three of these, for levels at $E_X$ = 3.54, 3.68, and 3.93 MeV with $J^\pi$ = ½$^-$, ³/₂$^-$, and ⁵/₂$^-$, respectively, have not been reported earlier. The previous conflicting assignments for the levels at $E_X$ = 1.80 MeV have been resolved in favor of $J^\pi$ = ½$^-$. (auth)

**13558** LIFETIME OF NUCLEAR HOLE STATES CAUSED BY PHONON-HOLE COUPLING. Wagner, G. J.; Doll, P.; Knoepfle, K. T.; Mairle, G. (Max-Planck-Institut fuer Kernphysik, Heidelberg (F. R. Germany)). Phys. Lett., B; 57: No. 5, 413-416(4 Aug 1975).

Quasihole states in the 1d shells of $^{36,38,40}$Ar and $^{40,42,44,48}$Ca have been excited with the (d,$^3$He) reaction at 52 MeV. A phonon-hole coupling model reproduces the measured spreading widths typically within 10%. (auth)

**13559** EXPERIMENTAL INVESTIGATION OF THE NEUTRON–$\gamma$ COMPETITION IN 14.7-MeV FAST NEUTRON REACTIONS. Deak, F.; Gueth, S.; Inczedy, J.; Kiss, A. (Univ., Budapest). Acta Phys. Acad. Sci. Hung.; 38: No. 3, 209-213 (1975).

The energy spectra of the evaporated neutrons from $^{55}$Mn and $^{209}$Bi targets were investigated at 14.7 MeV bombarding energy in order to learn about the probability of the (n,n'$\gamma$) process at excitation energies where the evaporation of the second neutron was energetically allowed. The role of the $\gamma$ deexcitation proved to be negligible in the case of the Bi target, while the analysis of the measurements on Mn provided evidence for considerably larger $\gamma$ competition than expected on the basis of the usual statistical assumptions. (auth)

**13560** PION-CALCIUM SCATTERING IN THE $\alpha$-PARTICLE MODEL. Germond, J. F.; Wilkin, C. (University Coll., London (UK)). Nucl. Phys., A; 249: No. 3, 457-465(22 Sep 1975).

Elastic $\pi$-$^{40}$Ca scattering in the region of the first pion-nucleon resonance is calculated within the optical limit of Glauber theory on the basis of the naive-$\alpha$-particle model. When account is taken of the strong short-range repulsion between pairs of $\alpha$-particles, the predicted cross sections become quite close to those derived from the conventional nucleon model. However both predictions can be quite accurately parameterized as fuzzy black discs, and the significance of this for future experiments is briefly discussed. (NL)

**13561** LEVELS OF $^{41}$Sc FROM THE $^{40}$Ca(p,p)$^{40}$Ca REACTION. Koltay, E.; Mesko, L.; Vegh, L. (Institute of Nuclear Research, Hungarian Academy of Sciences, Debrecen, Hungary). Nucl. Phys., A; 249: No. 1, 173-181(8 Sep 1975).

Excitation functions have been measured for $^{40}$Ca(p,p)$^{40}$Ca in the energy range from $E_p$ = 2.35 to 4.85 MeV at four angles. The R-matrix formalism for multilevel cross sections was used to analyze the data; spins, parities, proton widths and reduced widths were extracted for thirty levels. Several new spin values have been deduced. A detailed comparison of the levels in the mirror system $^{41}$Ca-$^{41}$Sc is given. (NL)

**13562** HIGH RESOLUTION SCATTERING OF PROTONS FROM $^{54}$Fe. Braendle, H.; Meyer, V.; Salzmann, M. (Zurich Univ. (Switzerland)). Nucl. Phys., A; 249: No. 2, 269-283(15 Sep 1975).

Differential cross sections for proton elastic and inelastic scattering on $^{54}$Fe were measured at angles of 90°, 125°, 141° and 165° and proton energies from 3.25 to 4.33 MeV with an energy resolution of 450 eV. The absolute energies are known to 1 keV accuracy. Four analogue states could be identified. In at least one case the analogue state is fragmented into fine structure resonances. Spectroscopic factors were obtained using the resonance parameters from the data and calculated single particle widths. (NL)

**13563** TRANSFER OF THREE IDENTICAL NUCLEONS IN $^{16}$O + $^{48}$Ca. Fortune, H. T.; Henning, W.; Kovar, D. C.; Zeidman, B.; Eisen, Y. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 57: No. 5, 445-446(4 Aug 1975).

In the bombardment of $^{48}$Ca by $^{16}$O ions, three-proton "stripping" and three-neutron "pickup" reactions are observed with total yields approximately 45 mu b and 5 mu b, respectively. (auth)

# Nuclear Properties and Reactions, 59 ≤ A ≤ 89

*Refer also to abstracts 12130, 13015, 13507, 13524–13526, 13541–13543, 13546, 13548, 13550–13552, 13555, 13556, 13568, 13610, 13611, 13655, 13692, 13750, 13752, and 13762.*

**13564** (ANL-75-75, pp 64-66) ANOMALIES IN THE $^{72}$Ge (alpha, n)$^{75}$Se REACTION NEAR ISOBARIC ANALOG RESONANCES IN $^{76}$Se. Elwyn, A. J.; Monahan, J. E.; Lemming, J. F.; Rapaport, J.; Sample, M. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13565** (BNL-20680) ABSOLUTE MEASUREMENT OF THE CRITICAL SCATTERING CROSS SECTION IN COBALT. Glinka, C. J.; Minkiewicz, V. J.; Passell, L. (Brookhaven National Lab., Upton, N. Y. (USA)). 1975. 9p. (CONF-751209-18). Dep. NTIS $4.50.

From 21st annual conference on magnetism and magnetic materials; Philadelphia, Pennsylvania, USA (9 Dec 1975).

Small-angle neutron scattering techniques have been used to study the angular distribution of the critical scattering from cobalt above T/sub c/. These measurements have been put on an absolute scale by calibrating the critical scattering directly against the nuclear incoherent scattering from cobalt. In this way the interaction range $r_1$, which appears in the classical and modified Ornstein–Zernike expressions for the asymptotic form of the spin pair correlation function and is related to the strength of the spin correlations, has been determined. We obtain $r_1/a$ equals $0.46 \pm 0.03$ for the ratio of the interaction range to the nearest-neighbor distance in cobalt. This result is in good agreement with theoretical predictions. Lack of agreement among previous determinations of the ratio $r_1/a$ made in iron failed to provide a definitive comparison with theory. (auth)

**13566** (CEA-N-1791, pp 24-26) STUDY OF THE TWO-STEP PROCESSES INDUCED BY TWO PROTON TRANSFER REACTIONS: $^{74}$Ge, $^{76}$Ge($^{16}$O,$^{14}$C)$^{78}$Se,$^{78}$Se AND $^{100}$Mo($^{12}$C,$^{10}$Be)$^{102}$Ru. Cobern, M.; Lemaire, M. C.; Mermaz, M. C.; Sztark, H. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

In order to explain the different behavior of the angular distributions of two proton transfer reactions $^{74}$Ge, $^{76}$Ge($^{16}$O, $^{14}$C)$^{76}$Se, $^{78}$Se and $^{100}$Mo($^{12}$C,$^{10}$Be)$^{102}$Ru, two-step process has to be definitively invoked. (FR)

**13567** (CEA-N-1791, pp 207-210) EXPERIMENTAL STUDY OF THE GIANT RESONANCE AT AL60. Progress Report 1 October 1973–30 September 1974. Beil, H.; Bergere, R.; Carlos, P.; Daujat, P.; Garganne, P.; Fagot, J.; Lepretre, A.; de Miniac, A.; Veyssiere, H.; Solodukhov, G. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Experimental results concerning the giant dipole resonances of Ce, Te, Ge, and Se isotopes obtained at the 60 MeV Linac are presented. (FR)

**13568** (COO-3246-15) RESEARCH IN NUCLEAR CHEMISTRY. Annual Progress Report, September 15, 1974–September 14, 1975. Kaplan, M. (Carnegie-Mellon Univ., Pittsburgh, Pa. (USA). Dept. of Chemistry). Jul 1975. Contract AT(11-1)-3246. 73p. Dep. NTIS $5.50.

The nuclear chemistry research program at Carnegie-Mellon University includes studies of nuclear reactions induced by heavy ions, nuclear properties, nuclear transitions and decay, and the hyperfine interactions of nuclear moments with extranuclear environments. Gamma-ray angular correlation measurements in the decay of $^{75}$Se have been carried out, and the data indicate absence of appreciable perturbation in the $^5/_2^-$ intermediate nuclear state in $^{75}$As. Integral and time-differential perturbed-angular-correlation experiments in $^{181}$Ta have elucidated strong quadrupolar interaction effects in several compounds. The origins of the observed electric field gradients are traceable to chemical bonding effects. Studies have been made of the evaporation residues from complete fusion reactions induced by heavy ion beams in several target nuclei, using a new experimental technique. Measurements of energy spectra, angular distributions, and total cross-sections for these processes have been carried out for $^{16}$O + $^{27}$Al, $^{20}$Ne + Cu, and $^{20}$Ne + In. Proton evaporation spectra in coincidence with evaporation residues were determined in one case. In other studies, light fragments from the reaction of $^{12}$C with $^{65}$Cu were identified in a counter telescope, and cross sections for production of boron isotopes were determined by integration of the measured angular distributions of the several species. The cross-section for the process $^{12}$C + $^{65}$Cu yields $^{12}$B is found to be very much smaller than radioactivity measurements of $^{65}$Zn from the same reaction, and hence $^{12}$B and $^{65}$Zn are probably not correlated fragments in a two-body break-up. (auth)

**13569** (CRN/PN-74-10) SPECTROSCOPIC FACTORS MEASUREMENTS IN THE s,d AND f,p SHELLS BELOW AND ABOVE THE COULOMB BARRIER BY ($^3$He,d) REACTIONS. Baghdadi, A. (Centre National de la Recherche Scientifique, 67-Strasbourg (France). Centre de Recherches Nucleaires; Strasbourg-1 Univ., 67 (France)). 1974. 83p. (In French). INIS.

Thesis.

The overlap of t and d or $^3$He and d wave functions may be measured by one neutron transfer in (d,t) or one proton transfer in ($^3$He,d). The measurement of the resulting normalization constant has been performed in subcoulombic conditions in the case of $^{58}$Ni($^3$He,d)$^{59}$Cu and $^{60}$Ni($^3$He,d)$^{61}$Cu leading to the first $^3/_2^-$ and $^1/_2^-$ states with a position sensitive detector in a Buechner spectrograph. The result: $D^2 = 2.7 \pm 0.2\ 10^4$MeV$^2$ fm$^3$ is in agreement with the $D^2$ measurement for (t,d) reactions [$3.1 \pm 0.2\ 10^4$ MeV$^2$ fm$^3$] and with the theoretical value proposed by L. J. B. Goldfarg and coworkers. This result was used for a determination of the spectroscopic factors of the 1.379 MeV $^3/_2^-$ state, the 1.507 MeV

$\frac{1}{2}^-$ state and the 1.758 MeV $\frac{3}{2}^-$ state in $^{57}$Co. The subcoulombic approximation is also shown to be valid even in the case of (d,p) reactions, by the measurement of angular distributions and excitation curves of $^{60}$Ni(d,p) reactions leading to the excited states at 4.760 MeV (l = 2) and 4.907 MeV (l = 0). In the second part, some spectroscopic factors in the s-d shell were measured by ($^3$He,d) reactions at MP Tandem energies. In the case of $^{27}$Al ($^3$He,d)$^{28}$Si (states at 4.62, 6.88, 6.89, 9.32, and 0.38 MeV) the normalization constant $D_0^2$ (deduced from the subcoulombic $D^2$ value) together with the first order finite range approximation leads to spectroscopic factors in good agreement with Wildenthal theoretical results. For $^{28}$Si($^3$He,d)$^{29}$p however, the values are too high compared to $^{29}$Si. The conclusion is that it is better to use the DWBA treatment at subcoulombic energies everytime the experimental conditions may be fulfilled. (FR)

**13570** NEUTRON CAPTURE DIFFERENTIAL CROSS SECTION FROM THE SEMIDIRECT CAPTURE MODEL. Likar, A.; Potokar, M.; Cvelbar, F. (Univ. of Ljubljana, Yugoslavia). pp 151-154 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The differential cross section formula for neutron radiative capture is derived on the basis of the direct-semidirect model. Numerical results for neutron capture to three single particle levels in $^{88}$Sr are considered. It is found that the anisotropy in general is not small and is also dependent on the incident particle-target nucleus coupling interaction used in the calculation. (auth)

**13571** γ RAYS FROM FAST NEUTRON CAPTURE IN $^{89}$Y AND $^{140}$Ce. Lindholm, A. (Tandem Accelerator Lab., Uppsala); Nilsson, L.; Bergqvist, I.; Palsson, B. pp 239-243 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

γ-ray spectra from the reactions $^{89}$Y(n,γ)$^{90}$Y and $^{140}$Ce(n,γ)$^{141}$Ce have been recorded with a large NaI(Tl) scintillator for incident neutron energies between 6.2 and 10.9 MeV. Time-of-flight technique was used to reject undesirable background. The experimental results are compared with theoretical predictions of the semi-direct capture model. (auth)

**13572** NEUTRON RADIATIVE CAPTURE WIDTHS OF COBALT. Spencer, R. R.; Beer, H. (Kernforschungszentrum, Karlsruhe, Ger.). pp 280-284 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The neutron capture cross section of $^{59}$Co has been measured in the energy range from 6 to 200 keV using an 800 l liquid scintillator detector in conjunction with a pulsed 3 MV Van de Graaff. The excellent time resolution of the system (FWHM = 2.8 ns) permitted derivation of radiation widths for single s-wave resonances to 50 keV neutron energy. Average radiation widths of 0.564 ± 0.024 eV and 0.486 ± 0.016 eV were found for seven J = 3 resonances and ten J = 4 resonances, respectively. No significant correlation between $\gamma_n^0$ and $\gamma_\gamma$ was found for either spin state. The Maxwellian averaged cross-section for kT = 30 keV was found to be 72 mb over the region from thermal to 200 keV neutron energy (auth)

**13573** γ-DECAY OF RESONANCE STATES IN THE $^{58, 60, 62, 64}$Ni(p,γ) REACTION. Rudak, L. V.; Rudak, E. A. (Inst. of Physics, Minsk). pp 429 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The contributions of the simplest configurations to wave functions of highly excited states of $^{59, 61, 63, 65}$Cu are estimated. (auth)

**13574** (p,γ) SPECTROSCOPY NEAR A ≈ 90. Nottrodt, H. P.; Rauch, F.; Trehan, P. N. (Univ., Frankfurt am Main). pp 430-431 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

General aspects of (p,γ) reactions in the Zr mass region are discussed along with the experimental techniques. Results for the nuclei $^{87}$Y and $^{89}$Y obtained from such measurements are described. (auth)

**13575** INTERMEDIATE STRUCTURE IN $^{89}$Y(p,γ)$^{90}$Zr EXCITATION FUNCTIONS. Rippl, W.; Rauch, F.; Seim, B. (Univ., Frankfurt am Main). pp 432-433 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

Excitation functions of the reaction $^{89}$Y(p,γ)$^{90}$Zr have been measured for transitions to 6 final states, in the energy region $E_p$ = 2.17 – 4.80 MeV. These show pronounced fine structure. The energy-averaged curves show intermediate structure which is different for all transitions. (auth)

**13576** $^{65}$Cu ENERGY LEVELS USING THE (γ,γ') REACTION. Moreh, R.; Shahal, O.; Tenenbaum, J. (Nuclear Research Centre–Negev, Beersheva, Israel). pp 471-474 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

Elastic and inelastic resonance scattering of photons was used for studying the energy levels of $^{65}$Cu. The γ source was obtained from thermal neutron capture in Cr. The spins of the resonance levels at 8484 and 7939-keV were found to be $\frac{1}{2}$ and $\frac{3}{2}$, respectively. The partial and total radiative widths of the 8484 keV level were measured and found to be γ = (0.33 ± 0.03) eV, $\gamma_0/\gamma$ = 0.90 ± 0.05. (auth)

**13577** NUCLEAR RESONANCE OF γ RAYS AROUND 7 MeV. Lucas, R.; Martinot, M.; Nifenecker, H.; Fagot, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 490-495 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The elastic scattering of variable energy photons by various targets (Bi, Pb, Hg, Tl, Ta, Au, Ce, Sn, Y, Zr, Ni) was studied in the energy range of 5 MeV to 8.1 MeV. The results obtained allow the determination of elastic scattering cross-sections in the energy range studied. (3 figures) (auth)

**13578** SPIN ASSIGNMENTS WITH THE (n,γ) REACTION. Abrahams, K. (FOM–RCN Nuclear Structure Group, Petten, Netherlands). pp 591-604 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

A survey is given of the angular correlation methods in neutron capture γ-ray spectroscopy. The interference of wave functions with different spins and parities is treated in connection to this survey. Complementary model dependent methods are discussed briefly. (3 figures) (25 references) (auth)

**13579** CIRCULAR POLARIZATIONS OF CAPTURE γ-RADIATION IN THE $^{64, 66, 68}$Zn(n,γ)$^{65, 67, 69}$Zn REACTION. de Boer, J. (FOM–RCN Nuclear Structure Group, Petten, Netherlands). pp 609-613 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The circular polarization of γ rays from capture of polarized thermal neutrons in $^{64, 66, 68}$Zn has been measured. The analysis of 15 primary transitions yields 11 unique spin assignments and 4 possible spin values. Neutron separation energies have been deduced for the 3 reactions. (auth)

**13580** EXPERIMENTAL DEVELOPMENTS. Van Assche, P. H. M. (SCK/CEN, Mol, Belgium). pp 681-685 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

A survey of individual contributions on experimental developments is given. A new method for the determination of γ-ray energies is introduced and a series of new or improved instruments is discussed. The importance of using polarized neutron beams with higher intensity is emphasized. (auth)

**13581** INDICATION OF E4 GIANT-RESONANCE STRENGTH. Geramb, H. V.; Amos, K. (Univ., Melbourne). Lett. Nuovo Cim.; 14: No. 14, 526-528(6 Dec 1975).

Since nuclear scattering can excite all multipoles with comparable probability, the existence of any giant hexapole resonance strength should be evident in direct-excitation angular distributions. To test this one has reanalyzed the data from inelastic scattering of 155-MeV protons from yttrium-89. The analyses were made using a collective-model distorted-wave approximation with the optical-model parameters. Individual multipole cross sections are compared, the predominance of L = 2 angular momentum transfer to the target is certain. (JFP)

**13582** PROBE SPECIFIC TEMPERATURE DEPENDENCE OF THE QUADRUPOLE INTERACTION OF $^{67}$Ge IN ZINC METAL. Bartsch, W.; Leitz, W.; Semmler, W.; Sielemann, R.; Wichert, T. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F. R. Germany). Bereich Kern- und Strahlenphysik). Phys. Lett., A; 54: No. 1, 66-68(11 Aug 1975).

The quadrupole interaction of the isomeric $^{9}/_{2}^{+}$ state of $^{67}$Ge was studied in zinc metal as a function of temperature by a DPAD method following the reaction $^{64}$Zn($\alpha$,n)$^{67}$Ge. The temperature dependence differs from that of a Zn probe in zinc metal. (auth)

**13583** LOW-LYING LEVELS AND THE MAGNETIC MOMENT OF THE 3$^+$ 213.5 keV STATE IN $^{72}$As. Bertschat, H.; Leithaeuser, U.; Recknagel, E.; Spellmeyer, B. (Hahn-Meitner-Institut fuer Kernforschung Berlin G.m.b.H. (F.R. Germany). Bereich Kern- und Strahlenphysik). Nucl. Phys., A; 249: No. 1, 93-102(8 Sep 1975).

Low-lying levels of $^{72}$As have been studied by excitation function, $\gamma\gamma$ coincidence, and neutron time-of-flight measurements using the reaction $^{72}$Ge(p,n). A new isomeric state at 213.5 keV was found. The spin-parity and half-life of this level were determined to be $I^{\pi}$ = 3$^+$ and $T_{1/2}$ = 80 (2)ns, respectively. The g-factor has been measured by the pulsed beam time-differential perturbed angular distribution method (DPAD) and found to be g = +0.527(6). (NL)

**13584** EVAPORATION RESIDUE CROSS SECTIONS FROM REACTIONS WITH ARGON IONS. Gauvin, H.; Guerreau, D.; Le Beyec, Y.; Lefort, M.; Plasil, F.; Tarrago, X. (Paris-11 Univ., 91-Orsay (France). Lab. de Chimie Nucleaire). Phys. Lett., B; 58: No. 2, 163-165(1 Sep 1975).

Evaporation residue cross sections have been measured in argon bombardments of Ni, Ge, Ag and Sb at energies ranging from 167 to 296 MeV. Earlier Sb results appear to be in error in the energy range above 200 MeV. Results are compared with statistical model calculations which include rotating liquid drop fission barriers. (NL)

**13585** SHORT-LIVED ACTIVITIES PRODUCED IN $^{70}$Zn WITH 14 MeV NEUTRONS. Reiter, W. L.; Breunlich, W. H.; Hille, P. (Institut fuer Radiumforschung und Kernphysik, Vienna, Austria.). Nucl. Phys., A; 249: No. 1, 166-172(8 Sep 1975).

Beta spectra have been studied after 14 MeV neutron irradiation of $^{70}$Zn. Beta-ray singles spectra and $\beta$-$\gamma$ coincidences using plastic and NaI(Tl) scintillation counters were measured to determine total decay energies for 1 + $^{70a}$Cu($T_{1/2}$ = 4 ± 1s) and for 5 – $^{70a}$Cu($T_{1/2}$ = 52 ± 4s). The decay energies found are 6.17 ± 0.11 MeV and 6.31 ± 0.11 MeV for $^{70a}$Cu and $^{70b}$Cu respectively. Five $\beta$-branches and four $\gamma$-rays could be placed in the decay scheme. A 3.83 ± 0.09 MeV $\beta$-branch belonging to the decay of $^{67}$Ni ($T_{1/2}$ = 16 ± 4s) has also been found. (NL)

# Nuclear Properties and Reactions, 90 ≤ A ≤ 149

*Refer also to abstracts 12096, 12135, 13140, 13507, 13514, 13525, 13526, 13528, 13542, 13546, 13548, 13552–13554, 13566–13568, 13571, 13575, 13577, 13580, 13584, 13641, 13655, 13699, and 13762.*

**13586** (ANL-75-75, pp 37, 38) $^{16}$O AND $^{18}$O INDUCED REACTIONS ON $^{118}$Sn AT THE COULOMB BARRIER. Eisen, Y.; Henning, W.; Koerner, H. J.; Kovar, D. G.; Schiffer, J. P.; Vigdor, S. E.; Zeidman, B. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13587** (ANL-75-75, pp 68, 69) MEASUREMENT OF THE g FACTOR OF THE 6$^+$, 88-mu SEC ISOMERIC STATE OF $^{90}$Nb. Mitchell, R. J.; Ragland, T. V.; Scharenberg, R. P.; Holland, R. E.; Lynch, F. J. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13588** (ANL-75-75, pp 74, 76, 77) MEASUREMENT OF THE g FACTOR OF THE 10-mu SEC ISOMERIC STATE OF $^{115}$Te. Mitchell, R. J.; Ragland, T. V.; Scharenberg, R. P.; Lynch, F. J.; Holland, R. E. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13589** (CEA-N-1791, pp 158-160) SAMARIUM MUONIC ATOMS. Barreau, P.; Powers, R. J.; Roussel, L. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Muonic X-rays of the sequence $^{144}$Sm, $^{147}$Sm, $^{149}$Sm were measured in order to describe the nucleon charge distribution. (FR)

**13590** (FRNC-TH-524) STUDY OF THE NUCLEAR MATTER DISTRIBUTION THROUGH $\alpha$ PARTICLE SCATTERING BY CADMIUM, TIN, TELLURIUM, SAMARIUM, AND LEAD ISOTOPES NEAR THE COULOMB BARRIER. Badawy, I. (Paris-11 Univ., 91-Orsay (France)). 1974. 91p. (In French). INIS.

Thesis.

The aim of this study was to establish the existence of an $\alpha$-nucleus interaction radius in the elastic scattering of $\alpha$ particles at energies near to the Coulomb barrier, and to obtain informations on matter distribution inside the nucleus. Measurements were carried out on the following twenty three nuclei: cadmium 110, 112, 114, 116, tin 112, 114, 116, 118, 120, 122, 124, tellurium 122, 124, 126, 128, 130, samarium 144, 148, 150, 152, and lead 204, 206 and 208. It was effectively possible to determine an $\alpha$-nucleus interaction radius, corresponding to a well defined nuclear potential, and whose slope as a function of $A^{\frac{1}{3}}$ is of the order of 1,36 fm. It was also possible to connect this nuclear potential to matter distribution and to determine inside this distribution a point where the nuclear density has a definitive value. A confirmation is given that neutrons in excess are preferentially distributed at the surface of nuclei and, as a consequence, make this surface more diffuse. (FR)

**13591** (INIS-mf-1743) MEASUREMENT OF TOTAL CROSS SECTIONS OF Cd, Ag, Bi AND Sr FOR NEUTRONS OF 18.44 TO 21.95 MeV. Maggi O, R. (Universidad Veracruzana, Jalapa (Mexico). Facultad de Ciencias). 1974. 75p. (In Spanish). INIS.

The total cross sections of natural Sr, Ag, Cd, and Si were measured for monoenergetic neutrons at energies from 18.44 to 21.95 MeV. The neutrons were produced by the T(d,n)$^4$He reaction using a solid blank containing T and were measured with a NE450 scintillation detector using a high value in the discriminator associated with the detector in order to eliminate $\gamma$ radiation and slow neutrons. The neutron flux was determined with a long counter detector. All the measurements were made using the transmission method and taking as a standard the total cross sections of the Karlsruhe laboratories in order to evaluate the background. The results obtained were graphed with a mean error of 5%. This includes the corrections for statistics, secondary scattering, in-scattering, and background. (tr-INIS)

**13592** (INIS-mf-1810) DECAY STUDIES ON SOME SHORT-LIVED ISOTOPES IN THE N = 50 REGION. de Lange, J. C. (Vrije Universiteit, Amsterdam (Netherlands)). 1975. 87p. INIS.

The results of the decay studies on the following activities are presented: $^{93g}$Ru → $^{93}$Tc $T_{1/2}$ = 59.7 sec, $^{93m}$Ru → $^{93}$Tc $T_{1/2}$ = 10.8 sec, $^{92}$Ru → $^{92}$Tc $T_{1/2}$ = 3.65 min, $^{91}$Tc → $^{91}$Mo $T_{1/2}$ = 3.14 min (and probably 3.3 min), $^{91g}$Mo → $^{91}$Nb $T_{1/2}$ = 16.6 min, $^{91m}$Mo → $^{91}$Nb $T_{1/2}$ = 65.1 sec. The activities $^{92m}$Ru and $^{91}$Tc were observed for the first time. Systematical trends in the properties of these nuclei and, where possible, comparisons with theoretical calculations are discussed. A remarkable correspondence in the properties of the isotones $^{91}$Nb and $^{93}$Tc was found. $^{92}$Tc was also investigated with the $^{92}$Mo (p,n$\gamma$) $^{92}$Tc reaction. An expected $(\pi g_{9/2}) \times (\nu g_{9/2})^{-1}$ multiplet was established. A previously measured mean lifetime of 1.5 $\mu$sec was assigned unambiguously to the second excited state in $^{92}$Tc. (auth)

**13593** (INIS-mf-1828) ISOBARIC ANALOGUE RESONANCES IN YTTRIUM AND IODINE. van Eeghem, W. P. T. M. (Technische Hogeschool Eidhoven (Netherlands)). 21 Feb 1975. 99p. INIS.

Thesis.

Isobaric analog resonances observed in the differential cross section for scattering of protons from heavier nuclei (N,Z) are considered. From the study of these resonances, occurring in

the continuum spectrum of the compound nucleus (N,Z+1), information can be obtained on bound states (parent states) of the isobaric nucleus (N+1,Z). In chapter 1 attention is paid to the description of such resonances in terms of the Lane model. Furthermore, we describe what kind of information on the parent states can be extracted from the various experiments. In chapter 2 experimental results on elastic scattering of unpolarized protons from $^{84}$Sr are given and analyzed. From this analysis optical model and resonance parameters are found. A compound contribution to the cross section is included in the resonance analysis. Spectroscopic factors have been calculated using modified R-matrix theory as well as the Lane model. Chapter 3 describes the experimental procedure followed in performing experiments with a polarized proton beam. In particular, the polarized proton source is described briefly. Chapters 4 and 5 deal with elastic scattering of polarized protons from the strontium isotopes $^{84}$Sr, $^{86}$Sr and the tellurium isotopes $^{130}$Te, $^{128}$Te, $^{126}$Te, $^{124}$Te, respectively. (INIS)

**13594** (INR-P-1172/1/PL) ISOMERIC CROSS SECTION RATIOS AND TOTAL CROSS SECTIONS FOR THE $^{113}$In(n,2n)$^{112g,m}$In AND $^{115}$In(n,2n)$^{114g,m}$In REACTIONS. Grochulski, W. Karolyi, J.; Marcinkowski, A.; Piotrowski, J.; Saad, E.; Siwek, K.; Wilhelmi, Z. (Institute of Nuclear Research, Warsaw (Poland)). 1970. 12p. INIS.

The isomeric ratios and excitation functions were measured for the $^{113}$In(n,2n)$^{112g,m}$In and $^{115}$In(n,2n)$^{114g,m}$In reactions in the neutron energy range 12 to 18 MeV. The results were compared with the statistical model predictions. The agreement between the experimental and theoretical isomeric ratios is good. (auth)

**13595** (ORNL-TM-5097) Mo(n,x gamma) REACTION CROSS SECTION FOR INCIDENT NEUTRON ENERGIES BETWEEN 0.2 AND 20.0 MeV. Morgan, G. L.; Newman, E. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 54p. (ENDF-220). Dep. NTIS $5.50.

Differential cross sections for the neutron-induced gamma-ray production from natural molybdenum have been measured for incident neutron energies between 0.2 and 20.0 MeV. The Oak Ridge Linear Accelerator (ORELA) was used to provide the neutrons and a NaI spectrometer to detect the gamma rays at 125$^0$. The data presented are the double differential cross section, d$^2$sigma/dOMEGAdE, for gamma-ray energies between 0.3 and 10.6 MeV for coarse intervals in incident neutron energy. The integrated yield of gamma rays of energies greater than 300 keV and higher resolution in the neutron energy is also presented. The experimental results are compared with the Evaluated Neutron Data Files (ENDF). 24 figures, data tables. (auth)

**13596** WIDTH CORRELATIONS AND INTERMEDIATE STRUCTURE IN THE n-$\gamma$ SPECTRA OF Au, Sb, I, AND Tb. Jain, A. P.; Cauvin, B.; Lottin, A. (CEN, Saclay, France). pp 165-170 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

Search for non-statistical effects in the resonance neutron capture $\gamma$-ray spectra of Au, Sb, I, and Tb is made through observation of width correlations and through detection of intermediate structure in the intensity of high energy $\gamma$-rays. A high correlation of 0.96 for Tb and zero values for Au and I are in agreement with the door way state hypothesis of Lane. The $^{159}$Tb data show the first conclusive evidence of an intermediate structure at 180 eV with a width of 40 eV. From several experimental facts, it is concluded that the neutron capture decay process in $^{197}$Au is completely statistical in character in contrast to the earlier belief of a 2p-1h door way state hypothesis for this nucleus. (auth)

**13597** GAMMA-RAYS FROM NEUTRON CAPTURE IN AND BETWEEN RESONANCES. Chrien, R. E. (Brookhaven National Lab., Upton, NY). pp 247-270 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Experiments on neutron capture gamma-ray emission in and between resonances, and the extent of their conformity to, or departure from, purely statistical assumptions are examined. Resonance capture with subsequent radiative transitions to discrete final states can be a powerful tool in nuclear spectroscopy, with the non-specific character of the (n,gamma) reaction leading to populating states of differing nuclear structure. Capture between resonances, however, is expected to be influenced by direct components. Capture gamma-ray spectra obtained in the off-resonance region can be fitted with interfering resonance and background amplitude terms, and the direct component extracted. Near neutron strength function peaks, especially near the 3s and 3p maxima, width correlations are clearly seen in resonance and resonance-averaged spectra. Valence transitions are shown to be inadequate to describe these correlations. (auth)

**13598** $\gamma$ DECAY OF RESONANCE STATES IN THE $^{92,\ 98}$Mo (n,$\gamma$) REACTION. Rudak, L. V.; Rudak, E. A. (Inst. of Physics, Minsk). pp 291 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The contributions of the simplest configurations to wave functions of highly excited states of $^{93}$Mo and $^{99}$Mo are estimated. (auth)

**13599** INVESTIGATION ON NON-STATISTICAL EFFECTS ASSOCIATED WITH RESONANCE NEUTRON CAPTURE $\gamma$-RAYS IN THE $^{93}$Nb(n,$\gamma$)$^{94}$Nb REACTION. Haste, T. J. (Oxford Univ.); Thomas, B. W. pp 294-299 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

Measurements have been made of neutron resonance capture $\gamma$-ray spectra in the reaction $^{93}$Nb(n,$\gamma$)$^{94}$Nb, to investigate non-statistical effects associated with primary transitions. Resonance spin assignments for s- and p-wave resonances have been made using low energy transitions. The neutron binding energy and final state energies, spins and parities have been determined. A significant correlation has been observed between (d,p) and resonance averaged (n,$\gamma$) reduced partial radiation widths to the same final states. No significant correlation was seen between reduced neutron widths and partial radiative widths, or among radiative width pairs. An interpretation in terms of the presence of a doorway state is suggested. (auth)

**13600** LOW ENERGY $\gamma$-RAYS FROM RESONANCE NEUTRON CAPTURE IN $^{133}$Cs AND $^{167}$Er. Riehs, P. (Research Center, Seibersdorf, Austria); Thomas, B. W. pp 300-305 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The intensities of prominent low-energy $\gamma$-transitions in $^{133}$Cs(n,$\gamma$) and $^{167}$Er(n,$\gamma$) have been measured for a number of neutron resonances using a Ge(Li) detector. Both nuclides indicate a grouping of s-wave capture spins 3 and 4. Spin assignments and $\gamma$-cascade calculations for population rates of low-energy levels have been made. (auth)

**13601** LOW AND HIGH ENERGY $\gamma$ RAYS FROM RESONANCE NEUTRON CAPTURE IN $^{143}$Nd. Rohr, G.; van der Veen, T.; Weigmann, H.; Winter, J. (EURATOM, Geel, Belgium). pp 306-312 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

Earlier measurements of $\gamma$-ray spectra from neutron capture in $^{143}$Nd resonances have been extended to 1210 eV neutron energy. Resonance spins are obtained from the low level population method as well as from the observation of primary transitions to $2^+$ final states. The anticorrelation between strengths of primary transitions to one- and two-phonon final states observed before, is further investigated. (auth)

**13602** ENERGY LEVELS IN THE ODD-N Sm ISOTOPES. Smither, R. K. (Argonne National Lab., IL). pp 358-363 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands, Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Four different types of neutron capture gamma-ray experiments are used to investigate the energy level structure of the odd-N Sm isotopes. The gamma ray branching ratios for the low-lying levels are used to help follow the level structure from the well-deformed $^{155}$Sm and $^{153}$Sm nuclei, through the transitions, $^{151}$Sm, $^{149}$Sm and $^{147}$Sm nuclei, to the near-spherical $^{145}$Sm nucleus. (auth)

**13603** AVERAGE p-WAVE RESONANCE CAPTURE SPECTRA FROM ISOTOPES OF MOLYBDENUM. Rimawi, K.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). pp 364-367 of Neutron

Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A 24 keV Fe-filtered beam has been used to study p-wave capture on even Mo targets. The capture gamma-ray spectra show pronounced correlations with final state spectroscopic factors. The valence model is only of limited success in accounting for these correlations. (auth)

**13604** NEUTRON CAPTURE IN Nb AT E/sub n/ equals 24 keV. Rimawi, K.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). pp 368-370 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Gamma-rays resulting from 24 keV neutron capture on niobium are observed to confirm previously reported correlations from resonance capture at lower energies. The correlation coefficient with (d,p) stripping widths is about 0.5. (auth)

**13605** ENERGY DEPENDENCE OF PARTIAL P-WAVE CROSS SECTION. Hla Pe; Allen, B. J.; Kenny, M. J.; Bird, J. R. (Australian Atomic Energy Commission, Lucas Heights). pp 374-377 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

A measurement is reported of the neutron energy dependence of four p-wave partial capture cross sections in cadmium isotopes.

**13606** $(n,\gamma\alpha)$ REACTION WITH RESONANCE NEUTRONS. Popov, Yu. P. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 379-394 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

New data on $\gamma$-transitions between compound states in the $(n,\gamma\alpha)$ reaction are considered. The results of investigation of the $^{143}$Nd$(n,\gamma\alpha)$ reaction give evidence for the predominance of M1 $\gamma$-transitions. The value of the radiation strength function has been found to be near to that for hard $\gamma$-transitions. (auth)

**13607** $(n,\alpha)$ AND $(n,\gamma\alpha)$ REACTIONS ON $^{143}$Nd, $^{149}$Sm, AND $^{147}$Sm. Emsallem, A. (Inst. of Nuclear Physics, Lyon); Asghar, M. pp 395-400 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The highly pure thermal neutron beam from the 87 m curved neutron guide at the Grenoble high flux reactor has been used to study the $(n_n,\alpha)$ and $(n_n,\gamma\alpha)$ reactions on $^{143}$Nd, $^{149}$Sm, and $^{147}$Sm target nuclei. The cross sections for the $\alpha$-particle lines seen in the $(n_n,\alpha)$-reactions are given and discussed. The $(n_n,\gamma\alpha)$ reaction cross sections on $^{143}$Nd, and $^{149}$Sm, and $^{147}$Sm are respectively $1.3 \pm 0.3$ mb, $1.75 \pm 0.4$ mb and $< 35$ $\mu$b. (auth)

**13608** LEVEL POPULATION IN $^{104,106}$Pd IN THE INELASTIC SCATTERING OF REACTOR FAST NEUTRONS. Govor, L. I.; Demidov, A. M.; Ahmed, M. R.; Shakarchi, Kh. I.; Al-Najjar, S.; Al-Amili, M. A.; Al-Assafi, N. pp 475-480 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

Spectra of $\gamma$-rays from the inelastic scattering of reactor fast neutrons on $^{104,106}$Pd have been measured. Level and $\gamma$-transition schemes of these nuclei have been constructed. Comparison is made between the level populations obtained from the $(n,n'\gamma)$ reaction and those calculated with a statistical model. Agreement between the experimental and theoretical values for $0^+$ and $2^+$ levels and differences of about a factor of 2 for $3^-$ and $4^+$ levels are established. (3 figures, 1 table) (auth)

**13609** NUCLEAR LEVELS OF $^{139}$La IN THE 7.28 MeV REGION USING A NEW $\gamma$ MONOCHROMATOR. Jacob, I.; Moreh, R.; Wolf, A. (Nuclear Research Center–Negev, Beersheva, Israel). pp 481-484 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

A lead target which resonantly scatters the 7.279 MeV line of neutron capture $\gamma$ rays of iron was used as a source of variable energy $\gamma$-radiation. Variation of the angle of the resonantly scattered beam between 60° and 120° permits an energy variation, $\Delta E = 275$ eV, below the resonant energy. In $^{139}$La, a transmission experiment using a $^{139}$La absorber has yielded 3 dips in the above angular range. The values of $g\gamma_0$ of these levels, and the nuclear level spacing in $^{139}$La are deduced. (auth)

**13610** DISTRIBUTION OF INTENSE LINES IN $\gamma$-RAY SPECTRA FROM THE INELASTIC SCATTERING OF REACTOR FAST NEUTRONS. Ahmed, M. R. (Nuclear Research Inst., Baghdad); Rammo, N.; Demidov, A. M. pp 496-501 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

Study of more than 30 spectra of $\gamma$-rays from the inelastic scattering of reactor fast neutrons on elements and isotopes has made it possible to classify all nuclei into five typical groups according to the pattern of the intense $\gamma$-line distribution in the $(n,n'\gamma)$ reaction: (1) light nuclei with $A \lesssim 30$, (2) even–even spherical nuclei, (3) even–even nuclei in the rare-earth region, (4) odd spherical nuclei, and (5) prolate nuclei with odd A in the rare-earth region and even–even prolate heavy nuclei. (6 figures) (auth)

**13611** THERMAL- AND LOW-ENERGY NEUTRON CAPTURE $\gamma$-RAY SPECTROSCOPY. Schult, O. W. B. (Kernforschungsanlage, Juelich, Ger.). pp 505-519 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

A short description is given of the various methods and techniques employed for the measuring of high- and low-energy $\gamma$-radiation and conversion electron spectra following thermal and low-energy resonance neutron capture. The kind and quality of the resulting data is discussed and compared with $\gamma$-ray data obtained from heavy-ion induced reactions. The current $(n,\gamma)$ activity is very briefly summarized. (3 figures, 40 references) (auth)

**13612** SHELL MODEL STATES IN $^{100}$Tc. Heck, D. (Institut fuer Angewandte Kernphysik, Karlsruhe, Ger.); Pinston, J. A.; Boerner, H.; Koch, H. R.; Roussille, R. pp 520-525 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The $\gamma$-ray spectrum following thermal neutron capture in $^{99}$Tc has been studied with a curved crystal spectrometer and various Ge(Li) and Si(Li) detectors. More than 1150 $\gamma$-lines could be observed. Based upon the precise $\gamma$-energies obtained with the curved crystal spectrometer and $\gamma\gamma$ coincidence measurements, a preliminary level scheme of $^{100}$Tc is proposed showing 8 excited states and 19 transitions. Possible shell model configurations are discussed. (auth)

**13613** THERMAL NEUTRON CAPTURE OF $^{142}$Ce. Gelletly, W. (Univ. of Manchester, Eng.); Kane, W. R.; Casten, R. F. pp 526-531 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The gamma-rays from thermal neutron capture on $^{142}$Ce have been studied in singles and coincidence with Ge(Li) detectors. A level scheme for $^{143}$Ce has been established. The intensities of the primary gamma-rays to levels below 2 MeV appear to be correlated with the strengths of excitation of the levels in the (d,p) reaction, which suggests that direct capture is important in this reaction. (auth)

**13614** $^{101}$Mo LEVEL AND $\gamma$-DECAY SCHEME BY THERMAL NEUTRON CAPTURE IN $^{100}$Mo. Kardon, B.; Seyfarth, P.; Goettel, P.; Gueven, H. H. (Kernforschungsanlage, Juelich, Ger.). pp 544-548 of Neutron Capture $\gamma$-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture $\gamma$-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The $\gamma$-radiation following thermal neutron capture in $^{100}$Mo has

been studied by single and coincidence measurements. A $^{101}$Mo level scheme has been deduced and is compared with the results of previous (d,p), (n,γ) and $^{101}$Nb decay studies. The existence of the first excited state at 13.51 keV has been confirmed. The present data yield a neutron binding energy of 5398.4 keV. (auth)

**13615** LOW-ENERGY $^{107}$Ag (n,γ) SPECTRUM AND LEVEL SCHEME OF $^{108}$Ag. Breitig, D. (Technische Univ., Munich); Baader, H. A.; Wimmer, L.; Heim, U.; Hoch, H. R.; Schult, O. W. B. pp 549-551 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

About 500 γ-lines with energies from 40 to 1150 keV following slow-neutron capture in $^{107}$Ag have been measured with the bent-crystal spectrometer at Risφ. These data were taken with very high resolution and energy accuracy and they were used for the construction of a decay scheme of $^{108}$Ag containing 17 levels with excitation energies up to about 600 keV. (auth)

**13616** LEVEL SCHEME OF $^{134}$Cs WITH BRANCHING RATIOS AND LIFETIMES. Rabenstein, D. (Technische Univ., Munich). pp 552-556 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

High- and low-energy γ-spectra from the reaction $^{133}$Cs(n,γ)$^{134}$Cs γ-γ-coincidences and lifetimes have been measured. A level scheme which contains most of the strong low-energy γ-transitions is presented and two lifetimes are reported. Tentative spin-parity values are proposed. In particular, several members of the $g_{\frac{7}{2}}h_{\frac{11}{2}}$ and $d_{\frac{5}{2}}h_{\frac{11}{2}}$ multiplets have been identified. (auth)

**13617** THERMAL NEUTRON CAPTURE IN $^{142}$Nd. Mirza, J. A.; Khan, A. M.; Irshad, M.; Schmidt, H. A.; Ishaq, A. F. M.; Anwar-ul-Islam, M. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). pp 557-561 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The $^{142}$Nd(n,γ)$^{143}$Nd reaction has been investigated with thermal neutrons. Energies and intensities of the resulting γ-rays in the energy range of 0.1 to 5.6 MeV have been measured using a three crystal Ge(Li)-NaI(Tl) spectrometer. Out of the 400 observed transitions, about 250 have been assigned to $^{143}$Nd by comparison with a natural neodymium spectrum. Prompt γ-γ coincidence for low energy γ-rays have also been studied with Ge(Li) detectors. A preliminary level scheme based on the present singles and coincidence data is presented. The Q-value for the reaction is estimated to be 6122.7 ± 0.5 keV. (auth)

**13618** ENERGY LEVELS IN $^{144}$Nd. Raman, S. (Oak Ridge National Lab., TN); Slaughter, G. G.; Harvey, J. A.; Jurney, E. T.; McClure, D. A.; Wells, J. C. Jr.; Lin, J. pp 562-564 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

An energy level scheme for $^{144}$Nd is constructed with 58 excited states below 3.5 MeV. This scheme is based mainly on singles (n,gamma) measurements with both thermal and resonance neutrons and on Ge(Li)-Ge(Li) coincidence measurements following thermal capture. The energy levels in $^{144}$Nd populated in the $^{143}$Nd(n,gamma) reaction with thermal and resonance neutrons are investigated. The spin and parity of the $^{143}$Nd ground state are $\frac{7}{2}^-$. The capture of s-wave neutrons, therefore, leads to $3^-$ or $4^-$ capturing states. (auth)

**13619** SPINS AND PARITIES FOR SOME $^{144}$Nd LEVELS. Rabenstein, D. (Technische Univ., Munich); Berzins, J. J.; Krumina, A. J.; Neiburgs, L. A.; Prokofjev, P. T. pp 565 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

$^{144}$Nd was investigated at the reaction $^{143}$Nd(n,γ)$^{144}$Nd. The single γ-ray spectrum and γ-γ coincidence were measured in the energy region 80 to 2500 keV, the conversion electron spectrum from 150 to 2000 keV. Multipolarities were determined for several transitions. The analysis of results allows to construct the level scheme for $^{144}$Nd containing 22 levels up to the 3000 keV excitation energy. The 2218.0 keV level is proposed for the first time basing on the strong coincidence between 476.8 and 426.8 keV lines. The possible spin and parity are $6^+$ ov $7^+$. The 2420.0 and 2452.6 keV levels are also confirmed by coincidences, and the most probable characteristics for the 2420.0 keV level are $5^+$, $4^+$. (auth)

**13620** $^{144}$Nd(n,γ)$^{145}$Nd REACTION. Najam, M. R.; Ishaq, A. F. M.; Anwar-ul-Islam, M.; Khan, A. M.; Mirza, J. A. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). pp 566-570 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The external geometry (n,γ) facility of PARR has been used to investigate the thermal neutron capture in $^{144}$Nd. A three crystal Ge(Li)-NaI(Tl) spectrometer has been used to measure the energies and intensities of the resulting γ-rays, in the energy range of 0.1 to 5.8 MeV. Out of 300 observed transitions about 110 have been assigned to $^{145}$Nd by comparison with a natural neodymium target spectrum. A preliminary decay scheme consisting of 15 excited states is also presented. The Q-value of the reaction is estimated to be 5755.3 ± 0.7 keV. (auth)

**13621** TIME-DIFFERENTIAL NEUTRON CAPTURE γ-RAY SPECTROSCOPY OF $^{168}$Er AND $^{134}$Cs. Simic, J.; Stojanovic, M.; Bogdanovic, M.; Slavic, I.; Lalovic, B.; Koicki, S. (Boris Kidric Inst., Belgrade). pp 574-577 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

Coincidence measurements have been made with Ge(Li) and NaI(Tl) detectors to investigate the population of the 1094 keV ($T_{\frac{1}{2}}$ = 112 ns) isomeric level in $^{168}$Er and 173 keV ($T_{\frac{1}{2}}$ = 57 ns) isomeric level in $^{134}$Cs, excited in capture reactions with thermal neutrons. In $^{168}$Er coincidence spectra in an energy interval from 100 to 6700 keV have been measured. In total about 200 γ-ray transitions in $^{168}$Er were found. (5 figures) (auth)

**13622** ANGULAR CORRELATION MEASUREMENTS OF γ-RAYS IN $^{105}$Ru AFTER THERMAL NEUTRON CAPTURE. Gueven, H. H.; Seyfarth, H.; Kardon, B.; Goettel, P. (Kernforschungsanlage, Juelich, Ger.). pp 614-618 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The γ-γ correlation of more than 40 cascades in $^{105}$Ru have been measured with very high statistical accuracy using two Ge(Li) detectors. On the basis of the extracted $A_2$ and $A_4$ coefficients, spins have been assigned to several excited states of $^{105}$Ru. In addition, high-resolution singles spectra have been measured in the low- and high-energy regions. (auth)

**13623** NEUTRON CAPTURE γ-RAY INVESTIGATIONS WITH THE BENT CRYSTAL SPECTROMETERS AT THE GRENOBLE HIGH-FLUX REACTOR. Boerner, H.; Goettel, P.; Koch, H. R.; Pinston, J.; Roussille, R. (Institut Max von Laue-Paul Langevin, Grenoble, France). pp 691-696 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The energy region from 30 to 1200 keV of neutron capture γ-ray spectra is investigated with the diffraction crystal spectrometers at the Institute Laue-Langevin. The performance for energies below 500 keV are: partial cross section of the weakest detectable transitions < 2 mb; for strong transitions: resolution < 200 eV, energy errors < 3 eV. (3 figures) (auth)

**13624** DETERMINATION OF NUCLEAR LIFETIMES BY THE USE OF THE BLOCKING EFFECT. Gibson, W. M. (Bell Telephone Labs., Inc., Murray Hill, N. J. (USA)). pp 129-162 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 May 1974).

This lecture is presented in essentially three parts: a rather general description and a review of the various types of work going on in the field of nuclear lifetimes measurements using blocking techniques; a discussion of the analysis of the way in which one arrives at nuclear information from the measurements, this topic being closely connected to the use of particle channeling for location analysis of impurity ion; a description of a particular case (proton-scattering in Ge). This case is used to illustrate the kind of nuclear physics questions that one can study and to make some detailed comparison of experimental results to calculations. (FR)

**13625** BLOCKING WITH REALISTIC DECAY FUNCTIONS. Uguzzoni, A.; Verondini, E. (Bologna Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Bologna (Italy)). pp 355-367 of Session d'Etudes sur la Canalisation des Particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 May 1974).

The influence of a non-exponential decay on the determination of compound nuclear reaction times by means of the blocking effect is discussed. In particular, with reference to the reaction $^{92}Mo(p,p')^{92}Mo(2^+, 1.5\ MeV)$, the applicability of a cut-off model is shown. The difference between the reaction times deduced from experiments for exponential and non-exponential decay is calculated. (FR)

**13626** HEAVY-ION FUSION CROSS SECTIONS. Broda, R.; Ishihara, M.; Herskind, B.; Oeschler, H.; Ogaza, S. (Neils Bohr Institutet, Copenhagen (Denmark)); Ryde, H. (Roskilde University Center, Roskilde, Denmark). Nucl. Phys., A; 248: No. 2, 356-376(25 Aug 1975).

The absolute cross sections for heavy-ion induced reactions in the rare earth region are studied systematically as functions of projectile energy, charge and mass. Targets and projectiles are chosen so that the same final states are fed in erbium, holmium and dysprosium nucleides with mass numbers A = 159-162. As the low lying states in these final nucleides are well known, the cross sections for the various reaction channels can be determined from singles $\gamma$-ray spectra. By summing these cross sections, the heavy-ion fusion cross sections are determined, and compared to theoretical calculations based on the Bass model as well as to total reaction cross sections deduced from optical model fits to elastic scattering data. (auth)

**13627** RECOIL STUDY OF Ar INDUCED MULTINUCLEON TRANSFER REACTIONS. Capture of 1 to 9 Charges by Rare-Earth Targets. Bimbot, R., Gardes, D., Hahn, R. L.; de Moras, Y.; Rivet, M. F. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 248: No. 2, 377-396(25 Aug 1975).

Multinucleon transfer reactions induced with 282 MeV Ar ions and involving the capture by the target of 1 to 9 charges have been studied. The targets were separated isotopes of rare earths from La to Tb. The experimental technique involved the measurement of the cross sections, angular distributions, and recoil ranges at each angle of the radioactive heavy residual nuclei $^{161}Dy$, $^{150}Dy$, and $^{149}Tb$. For a given number y of protons captured, the variation of the cross section versus $\Delta A$, the net gain of nucleons by the target, goes through a maximum for a value $\Delta A_m$ which depends on y; an increase on $\Delta A_m$ by two units is observed when y increases by one unit. The cross sections corresponding to these maxima decrease by a factor of about 1.5 to 2 when y increases by one unit. The total cross sections for the capture of > 4 charges by the target is estimated to be about 60 mb, relative to a total cross section of about 2 b. The cm angular distributions are peaked backwards, at an angle which varies from about 165° to about 175° as the number of transferred charges is increased from 3 to 7. The energy distributions in the cm system correspond to large losses of kinetic energy by the colliding partners. Analysis of these data, under the assumption of a two-body two-step process, gives results in accord with the following description: A "composite system" of projectile and target, with very short lifetime, is formed during the initial collision. Charge equilibrium is reached in this composite system before its scission into two intermediate fragments. Therefore, the intermediate nuclei have a neutron/proton ratio equal to that of the composite system. In a second much slower step, these excited fragments deexcite by nuclear evaporation. In this analysis, the basic assumption is made that most of the excitation energy is taken up by the heavy intermediate nucleus. In support of this hypothesis, it is shown that the inverse assumption, namely that the light nucleus carries a significant part of the excitation energy, leads to conclusions that are inconsistent with other experimental and theoretical studies. (auth)

**13628** DETERMINATION OF THE ISOTOPIC SHIFT OF THE FIRST RESONANCE LINE IN Cs(I) SPECTRUM FOR THE ISOTOPES $^{131}Cs$, $^{132}Cs$, AND $^{136}Cs$. Ullrich, S.; Otten, E. W. (Heidelberg Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Phys., A; 248: No. 2, 173-190(25 Aug 1975).

The isotope shifts of the resonance line $\lambda$ = 8521 Å of $^{131}Cs$, $^{132}Cs$, and $^{136}Cs$ with respect to $^{133}Cs$ were determined by a new scanning technique to be $\bar{\nu}(^{133}Cs) - \bar{\nu}(^{131}Cs) = +1.70(40)$ mk, $\bar{\nu}(^{133}Cs) - \bar{\nu}(^{132}Cs) = -0.95(80)$ mk, $\bar{\nu}(^{136}Cs) - \bar{\nu}(^{133}Cs) = -4.0(3.0)$ mk. In accordance with results from other Cs isotopes and neighboring elements they show the change $\langle \delta r^2 \rangle$ in the second radial moment of the nuclear charge distribution to be a factor of 5 to 10 smaller than expected from the model of uniform charge distribution. Integral isotope shifts over the isotopic chains of Xe, Cs, and Ba were analyzed in terms of collective models. Assuming an isotopic shift discrepancy of 0.5 for the nuclear volume shift it was possible to derive deformation parameters $\langle \beta^2 \rangle^{\frac{1}{2}}$ in quantitative agreement with those from B(E2) measurements. (auth)

**13629** DETERMINATION OF THE SPECTROSCOPIC QUADRUPOLE MOMENTS OF $^{131}Cs$, $^{132}Cs$, AND $^{136}Cs$. Ackermann, F.; Otten, E. W.; zu Putlitz, G.; Schenk, A.; Ullrich, S. (Heidelberg Univ. (F. R. Germany). Physikalisches Inst.). Nucl. Phys., A; 248: No. 2, 157-172(25 Aug 1975).

Nuclear spectroscopic quadrupole moments of the radioactive isotopes $^{131}Cs$, $^{132}Cs$, and $^{136}Cs$ have been determined from the hyperfine structure of the $6^2P_{\frac{1}{2}}$ state by the level crossing method. The results including a Sternheimer correction are: $Q_s(^{131}Cs) = -0.625(6)$ b, $Q_s(^{132}Cs) = +0.508(7)$ b, $Q_s(^{136}Cs) = +0.225(10)$ b. The quadrupole moments of all the Cs isotopes from A = 131 to A = 137 are recalculated. It is shown, that nuclear quadrupole moments of a specific isotope obtained from different atomic P-states only agree within the limits of error after application of the Sternheimer correction. The increase of $Q_s$ with decreasing neutron number conforms with other observations and theoretical calculations stating that for elements around Z = 55 nuclear deformation develops below N = 82. The staggering of the sign of $Q_s$ may be interpreted as consequence of an oblate-prolate degeneracy of the nuclear energy surface. Some magnetic moments have been slightly improved: $\mu_I(^{132}Cs) = 2.219(7)\ \mu_N$, $\mu_I(^{136}Cs) = 3.705\ (15)\ \mu_N$ (corrected for diamagnetism). (auth)

**13630** REORIENTATION EFFECT MEASUREMENTS IN $^{124}Te$, $^{126}Te$, AND $^{128}Te$. Kleinfeld, A. M. (Koeln Univ. (F. R. Germany). 1. Physikalisches Inst.); Maeggi, G.; Werdecker, D. (Koeln Univ. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 248: No. 2, 342-355(25 Aug 1975).

Coulomb excitation probabilities of the first $2^+$ states of $^{124}Te$, $^{126}Te$, and $^{128}Te$ have been determined. The measurement was performed by resolving the inelastically and elastically backward scattered $^4He$ and $^{16}O$ projectiles using an annular surface barrier detector. Quadrupole moments ($Q_2^+$) as well as the $B(E2, 0^+ \rightarrow 2^+)$ values were extracted by analyzing the excitation probabilities with the Winther-de Boer multiple Coulomb excitation program. The $Q_2^+$ deduced for the positive sign of the $2^{+\prime}$ interference term are $-0.41 \pm 0.08$ e · b, $-0.14 \pm 0.11$ e · b, and $-0.12 \pm 0.09$ e · b for $^{124}Te$, $^{126}Te$, and $^{128}Te$ respectively. (auth)

**13631** LOW-LYING $^{134}Cs$ EXCITED STATES FROM THE (n,$\gamma$) REACTION. Alexeev, V. L.; Emelianov, B. A.; Kabina, L. P.; Kaminker, D. M.; Khazov, Yu. L.; Kondurov, I. A.; Leushkin, E. K.; Loginov, Yu. E.; Rumjantsev, V. L.; Sakharov, S. L. (AN SSSR, Leningrad. Inst. Yadernoj Fiziki). Nucl. Phys., A; 248: No. 2, 249-275(25 Aug 1975).

Low-energy $\gamma$-ray and conversion electron spectra from the $^{133}Cs(n,\gamma)^{134}Cs$ reaction have been investigated with a bent crystal spectrometer, $\beta$-spectrometer, Ge(Li) and Si(Li) detectors. $\gamma$-$\gamma$ coincidence measurements were made with the Ge(Li)-Ge(Li) arrangement. $\gamma$-$\gamma$ delayed coincidences have been studied with the use of the Ge(Li)-NaI(Tl) coincidence set-up. The decay of 2.9 h $^{134m}Cs$ has been investigated with the prism $\beta$-spectrometer and Ge(Li) detector. The half-lives of the 176.403 and 257.112 keV levels have been measured to be 49.7 ± 0.8 ns and 12.3 ± 1.1 ns respectively. The neutron binding energy $B_n$ has been calculated to be 6891.4 ± 1.3 keV. Spin and parity assignments have been made for almost all the levels. The possible structure of the levels deduced is discussed. (auth)

**13632** ELASTIC AND INELASTIC SCATTERING OF 52 MeV PROTONS FROM $^{106}Pd$, $^{108}Pd$, AND $^{110}Pd$. Koike, M.; Suehiro, T.; Pingel, K.; Komura, K.; Nonaka, I. (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study); Wada, T.; Fujisawa, T.; Kamitsubo, H. (Institute of Physical and Chemical Research, Wako, Saitama (Japan)); Nojiri, T. (Tokyo Univ. of Education (Japan). Dept. of Physics). Nucl. Phys., A; 248: No. 2, 237-248(25 Aug 1975).

Elastic and inelastic scattering of 51.93 MeV protons from $^{106}Pd$, $^{108}Pd$, and $^{110}Pd$ has been studied. The angular distributions for the first $2^+$ and $3^-$ states were well reproduced by first-order distorted-wave and coupled-channel calculations on the basis of the collective vibrational model. The differential cross sections for the second $2^+$ states were well-fitted by coupled-channel calculations in which a small admixture of one-phonon states with the predominantly two-phonon states was assumed for the description of these states. The admixtures obtained were appreciably greater than those obtained from the B(E2) values in Coulomb excitation. The angular distributions for the first $4^+$ states showed strong diffraction patterns which were not

reproduced by the calculations, even in the mixed form. The two-phonon picture combined with the coupled-channel theory is still less successful in describing the $4^+$ states than the $2^+$ states. (auth)

**13633** GAMMA RAY ENERGY DOPPLER SHIFT ATTENUATION FOLLOWING COULOMB EXCITATION OF $^{113}$In AND $^{115}$In. Jerochina, K. I.; Zirgulevicius, R.; Lemberg, J. Ch.; Pasternack, A. A. (Leningrad Physical-Technical Inst.). Liet. Fiz. Rinkinys; 14: No. 5, 817-828(1974). (In Russian).

The Dopplershift attenuation method was used to measure the lifetimes of $^{113}$In and $^{115}$In exited levels populated via Coulomb exitation of $^{113}$In and $^{115}$In. The measured lifetimes are: $(0.8^{+0.4}_{-0.3})$ ps $(0.055^{+0.035}_{-0.015})$ ps, (0.43 ± 0.15) ps for the 1129.4 keV, 1172.2 keV, 1343.6 keV levels of $^{113}$In respectively and (1.15 ± 0.20) ps, (0.06 ± 0.02) ps, (0.45 ± 0.15) ps for the 1077.8 keV, 1131.7 keV and 1290.6 keV levels of $^{115}$In respectively. Lifetime of $^{113}$In 1025.1 keV level was found to be more than 2 ps. Multipolarity mixing parameters δ and B (M1) experimental values were calculated for γ−transitions from 1172.0 keV level to the ground state of $^{113}$In and from 1131.7 keV level to the ground state of $^{115}$In. (auth)

**13634** EXPERIMENTAL EVIDENCE OF A DIFFUSION PROCESS ASSOCIATED WITH THE MASS ASYMMETRY DEGREE OF FREEDOM IN HEAVY ION REACTIONS. Moretto, L. G.; Babinet, R. P.; Galin, J.; Thompson, S. G. (California Univ., Berkeley (USA). Dept. of Chemistry). Phys. Lett., B; 58: No. 1, 31-35(18 Aug 1975).

Dramatic changes of fragment angular distributions over a large range of atomic numbers in the reactions induced by $^{14}$N, $^{20}$Ne, and $^{40}$Ar on natural Ag targets are interpreted as evidence of a diffusion-controlled evolution of an intermediate complex along the mass asymmetry degree of freedom. (NL)

**13635** E2 TRANSITION RATES AND SENIORITY MIXING IN THE PROTON $1g_{9/2}$ ORBIT. Schneider, W. D.; Gonsior, K. H.; Guenther, C. (Bonn Univ. (F.R. Germany). Inst. fuer Strahlen- und Kernphysik). Nucl. Phys., A; 249: No. 1, 103-110(8 Sep 1975).

The half-lives of the lowest $2\frac{1}{2}^+$ states in $^{91}$Nb and $^{93}$Tc were measured with the pulsed beam direct timing method. The results are $T_{\frac{1}{2}}$ = 0.92 ± 0.10 ns and 1.61 ± 0.10 ns for $^{91}$Nb and $^{93}$Tc respectively. The known experimental data on E2 transition rates in N = 50 nuclei are analyzed in the light of a suggested seniority mixing in the proton $1g_{9/2}$ orbit. It is concluded that E2 matrix elements cannot be explained satisfactorily in the proton $p_{\frac{1}{2}}$ $g_{9/2}$ model space, even if free seniority mixing is allowed. (NL)

**13636** LEVEL SCHEME OF $^{137}$Nd FROM (α, xn) REACTIONS AND FROM β-DECAY OF THE $11\frac{1}{2}^-$ ISOMER OF $^{137}$Pm. Nowicki, G. P.; Buschmann, J.; Hanser, A.; Rebel, H. (Kernforschungszentrum Karlsruhe (F.R. Germany). Inst. fuer Angewandte Kernphysik); Faust, H.; Habs, D.; Klewe-Nebenius, H.; Wisshak, K. (Heidelberg Univ. (F.R. Germany). Physikalisches Inst.). Nucl. Phys., A; 249: No. 1, 76-92(8 Sep 1975).

The level scheme of $^{137}$Nd has been investigated by methods of in-beam γ-ray and conversion electron spectroscopy as well as by observing the γ-transitions following the β-decay of $^{137}$Pm. The γ-ray and conversion electron singles spectra, γγ coincidences and angular distributions of prompt γ-rays and conversion electrons were measured. The experimental data result in a detailed level scheme of $^{137}$Nd and allow the assignment of spin and parity to the β-decaying level in $^{137}$Pm, i.e., $I^\pi = 11\frac{1}{2}^-$. Members of a disturbed rotational band based on the $11\frac{1}{2}^-$ isomeric state of $^{137}$Nd and populated by prompt γ-transitions (high spin levels) as well as by the β-transitions of $^{137}$Pm (low spin levels) are identified. The negative parity levels are discussed in a particle-plus-rotator model with Coriolis coupling. Though the analysis results in evidence for a weak prolate deformation of $^{137m}$Nd, a quantitative description of the observed level scheme is not achieved. There are features which suggest that a γ-deformation of the core has to be taken into account. (NL)

**13637** HIGH RESOLUTION STUDY OF THE $^{118}$Sn(d,p)$^{119}$Sn REACTION AT 17 MeV. Borello-Lewin, T.; Orsini, C. Q.; Dietzsch, O.; Hamburger, E. W. (Sao Paulo Univ. (Brazil). Instituto de Fisica). Nucl. Phys., A, 249: No. 2, 284-300(15 Sep 1975).

Energy levels in $^{119}$Sn up to 4.75 MeV excitation have been studied with the $^{118}$Sn(d,p)$^{119}$Sn reaction at an incident deuteron energy of 17 MeV. The scattered particles were analyzed by a magnetic spectrograph and detected in nuclear emulsions with a resolution of approximately 9 keV. Seventy-seven energy levels were identified. Angular distributions were compared to DWBA predictions allowing the identification of transferred angular momenta and the determination of spectroscopic factors for 49 states. The results obtained are compared with pairing theory and the weak-coupling model. (NL)

**13638** RATIO OF K-CAPTURE TO POSITRON EMISSION IN THE DECAY OF $^{120}$Sb: EXPERIMENT AND THEORY DISAGREE. Campbell, M.; Ledingham, K.W.D.; Baillie, A. D.; Fitzpatrick, M. L.; Gourlay, J. Y.; Lynch, J. G. (Glasgow Univ. (UK). Dept. of Natural Philosophy). Nucl. Phys., A; 249: No. 2, 349-365(15 Sep 1975).

Recent review papers have indicated that experiment K-capture to positron emission ratios in allowed decays disagree with theory especially for high-Z nuclei. The experimental error has never been sufficiently small to verify this with certainty. The K-capture to positron emission ratio, $P_K/P_{\beta^+}$, in $^{120}$Sb has been measured with an uncertainty of about 3% and found to lie about 16% lower than the most recent theoretical predictions. (NL)

**13639** DIRECT-REACTION CROSS SECTIONS IN COLLISIONS BETWEEN HEAVY IONS. Henning, W.; Schiffer, J. P.; Kovar, D. G.; Vigdor, S.; Zeidman, B.; Eisen, Y.; Koerner, H. J. (Argonne National Lab., Ill. (USA)). Phys. Lett., B; 58: No. 2, 129-131(1 Sep 1975).

Cross sections for all transfer channels, as well as inelastic and elastic scattering have been measured near the Coulomb barrier for $^{16}$O + $^{118}$Sn and well above the barrier for $^{16}$O + $^{48}$Ca. The total direct cross sections are decomposed into partial wave contributions, the largest of which are found to be of the same order of magnitude as elastic scattering. The implications of these results for the mechanism of heavy-ion direct reactions is discussed. (NL)

**13640** g-FACTOR OF THE $6^+$ STATE OF $^{90}$Nb. Holland, R. E.; Lynch, F. J. (Argonne National Lab., Ill. (USA)); Mitchell, R. J.; Ragland, T. V.; Scharenberg, R. P. Phys. Lett., B; 58: No. 1, 43-45(18 Aug 1975).

The g-factor of the 88 mu s isomeric $6^+$ state of $^{90}$Nb has been measured by the time-differential perturbed-angular distribution method. The observed g-factor of 0.620 ± 0.004 agrees within the error with a recent measurement of the $8^+$ ground state of $^{90}$Nb and verifies additivity to this accuracy in $^{90}$Nb. (NL)

## Nuclear Properties and Reactions, 150 ≤ A ≤ 189

*Refer also to abstracts 12096, 13140, 13524, 13577, 13580, 13590, 13596, 13597, 13600, 13602, 13610, 13611, 13621, 13624, 13626, and 13699.*

**13641** (ANL-75-75, pp 143-144) NUCLEAR STRUCTURE OF $^{148}$Sm, $^{150}$Sm, AND $^{152}$Sm. Smither, R. K.; Bushnell, D. L. 1975.

In Physics Division annual review, 1 April 1974–31 March 1975. (Argonne National Lab., Ill. (USA)).

**13642** (CEA-N-1791, pp 37-39) STUDY OF $^{174}$Yb EXCITED LEVELS USING PROTON RESONANCE SCATTERING. Lamehi, M.; Levi, C.; Mittig, W. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973−30 September 1974.

The de-excitation of the $\frac{1}{2}^-$[510] isobaric resonance in $^{175}$Lu was investigated in order to get information on the microscopic structure of excited levels of $^{174}$Yb and especially to find and study the $\frac{1}{2}^-$[510] ± $\frac{5}{2}^-$[512] 2QP states. (FR)

**13643** (CEA-N-1791, pp 144-146) ELASTIC AND INELASTIC ELECTRON SCATTERING IN SAMARIUM ISOTOPES. Alster, J.; Bellicard, J. B.; Cochavi, S.; Guterman, A.; Haik, N.; Huet, M.; Leconte, P.; Moinester, M.; Turck, S. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973−30 September 1974.

New electron scattering measurements were carried out on samarium isotopes. An improved energy resolution (80 keV) allowed the lowest discrete levels belonging to rotational bands of samarium-152 and 154 to be separated. (FR)

**13644** (JAERI-M-6034) MULTIPLE SCATTERING OF NEUTRONS IMPINGING ON THICK MATERIALS IN THE RESONANCE ENERGY REGION. Ohkubo, M. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 25p. INIS.

A multiple scattering effect on neutron capture and scattering yields was measured for tungsten plates of several thicknesses in the resonance energy region with a $^6$Li-$^7$Li pair glass scintillator. Observed capture and scattering data were compared with the results obtained by the Monte-Carlo calculations. At resonance energies, the capture yields show peaks for thin

samples, whereas they show dips for thick samples. The reason for these complicated features are interpreted by investigating the distributions of neutron path length in the samples. A new method of Γn/Γ determination, which is essentially insensitive to the sample thickness, is discussed. (auth)

**13645** SPURIOUS EFFECTS OF THE DISPERSION IN THE NUMBER OF PARTICLES ON β-TRANSITIONS. Fellah, M.; Hammann, T. F. (Institut d'Etudes Nucleaires, Algeria). Nuovo Cim.; 30A: No. 2, 239-269(21 Nov 1975).

A general method is presented for eliminating, in the theoretical values of the first-forbidden beta-transitions, the unphysical effects due to the particle number fluctuation allowed by the usual BCS wave functions. Analytical expressions are given for the pertinent pairing correlation reduction factors, calculated with both BCS and strict particle-number-projected BCS wave functions. The treatment allows for the fact that parent and daughter nuclei do not have, generally, the same axial deformation. Furthermore, the blocking effect was exactly and systematically taken into account. Numerical calculations were performed with a wrought newly adopted Nilsson model, and compared to a computation of experimental data on odd-mass nuclei from the rare-earth region. In the majority of the beta-decays studied the elimination of the unphysical components in the wave functions improves the theoretical half-lives. The influence of the Coriolis interaction was studied in the first-order perturbation theory, and it was found that in general it worsens the ft values. (auth)

**13646** DIRECT CAPTURE STUDIES IN THE 4s GIANT RESONANCE REGION. Cole, G. W.; Chrien, R. E. (Brookhaven National Lab., Upton, NY). pp 271-276 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Non-resonant radiative capture of epithermal neutrons has been investigated for five targets in the range A equals 152 to 186. Significant direct reaction cross-sections are observed for final states of good single particle character. (auth)

**13647** SPINS OF RESONANCES IN $^{175}$Lu. Namenson, A. I.; Stolovy, A.; Smith, G. L. (Naval Research Lab., Washington, DC). pp 313-315 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

Spins of 49 neutron resonances in $^{175}$Lu have been determined up to 274 eV with better than 90% confidence. The method and results of calculating the relative populations and strength functions of resonances of spin 3 and 4 from the measurements will be discussed. (auth)

**13648** ENERGY LEVELS OF $^{155}$Gd AND $^{157}$Gd POPULATED BY THE (n,gamma) REACTION USING 24.5 keV NEUTRONS. Greenwood, R. C. (Aerojet Nuclear Co., Idaho Falls, ID); Reich, C. W.; Chrien, R. E.; Rimawi, K. pp 353-357 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The properties of a 24-keV neutron beam, obtained from HFBR through an Fe + Al + S filter, which make it a useful tool in nuclear spectroscopy have been studied. As an application of these techniques, the prompt gamma-rays from 24-keV neutron capture in $^{154}$Gd and $^{156}$Gd have been measured. (auth)

**13649** PHOTOEXCITATION OF THE GIANT DIPOLE RESONANCE IN $^{181}$Ta AND $^{237}$Np. Bar-Noy, T.; Moreh, R. (Nuclear Research Center-Negev, Beersheva, Israel). pp 485-489 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

The elastic and inelastic (Raman) photon scattering from $^{181}$Ta and $^{237}$Np for 5 energies between 8.5 and 11.4 MeV are measured. At 11.4 MeV, the results agree well with predictions of the simple rotator model (SRM) and the dynamical collective model (DCM) of the giant dipole resonance (GDR). At lower energies, the theoretical cross sections are obscured by the relatively large contribution of Delbruck scattering where the real amplitudes are not known accurately. (1 table, 3 figures) (auth)

**13650** TRANSITIONAL NUCLEUS $^{152}$Eu. Cooperation Munich-Livermore-Risoe-Tallahassee-Los Alamos-Riga-Juelich-Brookhaven. pp 532-536 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A level scheme of $^{152}$Eu is proposed based on (n,e), (n,gamma), (n,gamma gamma), (n/sub res/,gamma), (d,t), (d,p) and (p,d) experiments. Spin and parity assignments are given to many levels. The lifetimes of two levels were measured. The energy of the 0$^-$ isomeric state is 45.63 +- 0.02 keV. (auth)

**13651** OCTUPOLE QUASIROTATIONAL BANDS IN $^{150}$Sm. Berzins, J. J.; Krumina, A. J.; Prokofjev, P. T. (Inst. of Physics, Riga). pp 571 of Neutron Capture γ-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture γ-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920.

In order to investigate the $^{150}$Sm structure, the conversion electron spectrum in the energy interval 30 to 300 keV with a resolution 0.07% and the single γ-ray spectrum 700 to 2000 keV were measured additionally to the previous data. Analysis of the results of these measurements using the data on the $^{150}$Pm β-decay and on the resonance neutron capture in $^{149}$Sm allows one to determine and to confirm the spins for several negative parity levels. A comparison with the neighbor transitional region nuclei, except for the previously known $K^\pi = 0^-$ band, permits the identification of the octupole quasirotational band with $K^\pi = 1^-$ and possibly the $K^\pi = 2^-$ band. (auth)

**13652** LEVEL SCHEME OF $^{154}$Eu. Stoeffl, W.; Schreckenbach, K.; Rabenstein, D.; von Egidy, T. (Technische Univ., Munich). pp 572-573 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The level structure of $^{154}$Eu has been investigated by means of thermal neutron captured γ-rays and conversion electrons. A level scheme containing 15 levels has been established. The life time of 2 levels has been determined. (auth)

**13653** CAPTURE GAMMA-RAY RESEARCH AT LAWRENCE LIVERMORE LABORATORY. Mann, L. G.; Lanier, R. G.; Larsen, J. T.; Richards, W. J. (Univ. of California, Livermore). pp 578-583 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A filtered external neutron beam from the Livermore pool-type reactor is used for capture gamma-ray research. Two Ge(Li) detectors are used either singly or in coincidence. One detector can be operated in the Compton suppression mode and the other in the pair spectrometer mode. In coincidence work three parameters (E/sub gamma/, E/sub gamma/, t) are stored and analyzed. A bent crystal spectrometer of the Cauchois type has recently become operational for use with sources in the reactor through a tube. Recent data on $^{181}$Ta and $^{159}$Tb are presented. 6 figures. (auth)

**13654** INVESTIGATION OF SPINS FOR SOME LEVELS IN $^{166}$Ho. Bosman, J. J. (FOM-RCN Nuclear Structure Group, Petten, Netherlands); Delhey, P. P. J.; Postma, H. pp 638-642 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The intensities of primary gamma transitions following thermal neutron capture depend on the relative orientation of neutron and nuclear spin as well as on the direction of measurement. The spin of several levels in $^{166}$Ho could be unambiguously assigned by means of an (n,γ) experiment with polarized neutrons and polarized nuclei. (57 references) (auth)

**13655** NEUTRON CAPTURE CROSS-SECTION MEASUREMENTS FROM 0.01 TO 10 ELECTRON VOLTS. Widder, J. F. pp 757-759 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Absolute neutron capture cross-section measurements from 0.01 to 10 eV using a Moxon-Rae detector are described. For the calculation of multiple scattering and gamma-ray attenuation effects in samples new improved methods were developed. Cross-section curves were evaluated for vanadium, manganese, cesium,

europium, dysprosium, lutetium, tantalum as well as for the isotopes $^{151}$Eu, $^{153}$Eu, $^{175}$Lu and $^{176}$Lu. The accuracy attained is 2-3% from 0.01 to 1 eV and 3-5% above 1 eV. (auth)

**13656** INFLUENCE OF THE PROJECTION OF BCS FUNCTIONS ON THE M1 AND E2 TRANSITIONS IN RARE EARTHS. Fellah, M.; Hammann, T. F. (Institut d'Etudes Nucleaires, Algiers (Algeria)). J. Phys. (Paris); 36: No. 6, 461-470(Jun 1975). (In French)

E2 and M1 transition probabilities for odd-mass rare earth nuclei have been calculated using both the usual BCS wave functions and the strict particle-conserving, projected BCS functions. The blocking effect has been exactly and systematically taken into account. The influence of the Coriolis interaction has been studied using the first-order perturbation theory. Allowance has been made for the $\beta$ and $\gamma$ vibrations. The unphysical effects, due to particle fluctuation in the BCS theory, are not always negligible, but are in most cases less important than the Coriolis effect. (FR)

**13657** NANOSECOND ISOMERS IN $^{186}$W. Karwowski, H.; Jastrzebski, J. (Institute of Nuclear Research, Warsaw (Poland)); Majewski, S.; Pietrzyk, B.; Wencel, L. (Warsaw Univ. (Poland)). J. Phys. (Paris); 36: No. 6, 471-474(Jun 1975).

The levels of $^{186}$W fed in the $\beta$-decay of $^{186}$Ta and Ec decay of $^{186}$Re were investigated. The single spectrum and the delayed coincidence spectra were measured. The half-lives of three isomers in $^{186}$W were determined: $T_{\frac{1}{2}}$(1222.3 keV) = 1.036 ± 0.010ns, $T_{\frac{1}{2}}$ (952.4 keV) = 0.193 ± 0.015ns, $T_{\frac{1}{2}}$ (1661 keV) = 4.92 ± 0.10ns and the upper limit of the 1463 keV level half-life $T_{\frac{1}{2}} \leq 0.1$ ns was estimated. Two-quasiparticle excitations were calculated and their assignment to experimentally observed states is proposed. (FR)

**13658** STUDY OF THE SHAPE TRANSITION FROM OBLATE TO PROLATE BETWEEN $^{187}$Pt AND $^{185}$Pt. Deleplanque, M. A.; Gerschel, C.; Ishihara, M.; Perrin, N.; Ader, B. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 16, 515-518(28 Apr 1975). (In French)

The appearance of a decoupled band in $^{187}$Pt and a normal band in $^{185}$Pt from the $^{174}$Yb, $^{176}$Yb ($^{16}$O,5n) reaction allows a shape transition from oblate to prolate to be predicted between these two nuclei. (FR)

**13659** MAGNETIC PROPERTIES OF $^{166}$Er AND THE COLLECTIVE MODEL. Baker, K. R.; Hamilton, J. H.; Lange, J.; Ramayya, A. V.; Varnell, L. (Vanderbilt Univ., Nashville, Tenn. (USA). Dept. of Physics); Maruhn-Reswani, V.; Pinajian, J. J., Maruhn, J. A. (Oak Ridge National Lab., Tenn. (USA)). Phys. Lett., B; 57: No. 5, 441-444(4 Aug 1975).

The E2/M1 admixtures for nine $\gamma$-ground band transitions in $^{166}$Er were measured. Mixing ratios, $\delta$(E2/M1), were calculated based on a general treatment of magnetic properties in the framework of the collective model. The agreement with the experimental values is generally good. (auth)

**13660** DECAY OF 4 MIN $^{158}$Tm. Aguer, P.; Liang, C. F.; Libert, J.; Paris, P.; Peghaire, A. (Centre National de la Recherche Scientifique, 91-Orsay (France). Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse); Charvet, A.; Duffait, R.; Marguier, G. (Lyon-1 Univ., 69 - Villeurbanne (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 249: No. 2, 239-252(15 Sep 1975).

The decay of 4 min $^{158}$Tm has been investigated with on-line mass-separated samples obtained from the Orsay ISOCELE separator. Measurements of $\gamma$-rays, conversion electron lines and $\gamma$-$\gamma$ bi-dimensional coincidences were performed. About 180 transitions were ascribed to the decay and two-thirds of them were placed in a decay scheme. The $\beta$-band and the $\gamma$-band were identified with bandheads situated at 806.40 and 820.13 keV respectively. In addition, a number of other vibrational bands ($\beta$-$\gamma$, $\beta$-$\beta$, $K^{\pi} = 0^-$ and $1^-$) are proposed. The decay properties of those bands are discussed in the framework of current nuclear models. The log ft values suggest a $2^-$ assignment for $^{158}$Tm with the possible configuration [p404(spin down)-n521(spin up)]. (NL)

**13661** CORIOLIS-DECOUPLED BANDS IN $^{155,157,159}$Dy AND $^{155,157,159}$Er USING ($\alpha$,xn$\gamma$) REACTIONS. Beuscher, H.; Davidson, W. F.; Lieder, R. M.; Neskakis, A.; Mayer-Boericke, C. Kernforschungsanlage Juelich G.m.b.H. (F.R. Germany). Inst. fuer Kernphysik).

Levels in $^{155,157,159}$Dy and in $^{155,157,159}$Er have been populated using ($\alpha$, xn$\gamma$) reactions where x = 5, 7 or 9. The resulting $\gamma$-rays have been investigated using in-beam $\gamma$-spectroscopic techniques. Mixed positive-parity bands were predominantly populated and are identified with the Coriolis decoupled bands described in the framework of the rotation-alignment model of Stephens and coworkers. In the case of $^{157}$Dy the band was observed up to the $(41/2)^+$ state. The absence of the backbending effect in these nuclei can be explained by the blocking of certain $i_{13/2}$ neutron orbitals near the Fermi surface which are essential for the development of the backbending mechanism. (NL)

# Nuclear Properties and Reactions, 190 ≤ A ≤ 219

*Refer also to abstracts 12135, 13140, 13504, 13507, 13514, 13524, 13540, 13559, 13577, 13580, 13590, 13591, 13596, 13689, 13699, and 13700.*

**13662** (AECL-5226, pp 14-15) HALF-LIVES AND g-FACTORS IN $^{210}$Po. Haeusser, O.; Alexander, T. K.; Beene, J. R.; McDonald, A. B.; Earle, E. D. Aug 1975.

In Physics Division progress report, April 1-June 30, 1975.

**13663** (AECL-5226, pp 16) $15^-$ AND $11^+$ ISOMERIC STATES IN $^{212}$Fr. Haeusser, O.; Alexander, T. K.; Beene, J. R.; McDonald, A. B.; Earle, E. D. Aug 1975.

In Physics Division progress report, April 1-June 30, 1975.

**13664** (AECL-5226, pp 55) RESONANT ELASTIC SCATTERING OF GAMMA RADIATION FROM LEAD ISOTOPES. Knowles, J. W.; Mills, W. F.; Khan, A. M. Aug 1975.

In Physics Division progress report, April 1-June 30, 1975.

**13665** (CEA-N-1791, pp 200-201) MEASUREMENT OF THE CAPTURE CROSS SECTION FOR $^{197}$Au. Alix, M.; Paya, D. [nd]. (In French)

In Department of Nuclear Physics, Progress report 1 October 1973-30 September 1974.

The $^{197}$Au capture cross section was measured in order to test the detector. The results are in agreement with the published ones. The importance of the weight correction has been shown but the results do not seem to be very sensitive to the shape of the weight function. (FR)

**13666** (COO-3069-372) NUCLEAR GROUND STATE. Negele, J. W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Physics). 1975. Contract AT(11-1)-3069. 31p. (CONF-750990-1). Dep. NTIS $5.00.

From meeting on electron scattering at intermediate energy; Saclay, France (8 Sep 1975).

The nuclear ground state is surveyed theoretically, and specific suggestions are given on how to critically test the theory experimentally. Detailed results on $^{208}$Pb are discussed, isolating several features of the charge density distributions. Analyses of $^{208}$Pb electron scattering and muonic data are also considered. (14 figures) (SDF)

**13667** GIANT M1 RESONANCE IN Au. Lone, M. A. (Atomic Energy of Canada, Ltd., Chalk River, Ont.); Lee, H. C.; Fagg, L. W.; Bendel, W. L.; Jones, E. C. Jr.; Maruyama, X. K.; Lindgren, R. A. pp 191-195 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A gross resonance structure at 7.9 MeV with a FWHM of approx. 3 MeV is found in the Au(e,e') reaction. Comparison of the q-dependence of the observed cross-sections and those calculated in DWBA using microscopic transition densities for spin flip M1 transitions due to 5 particle-hole configurations indicate that this resonance is predominantly of M1 character with $\Gamma_{M1} \geq 144$ eV. (auth)

**13668** LOW-SPIN STATES IN $^{202}$Hg. Breitig, D.; Casten, R. F.; Kane, W. R.; Cole, G. W.; Cizewski, J. (Brookhaven National Lab., Upton, NY). pp 316-322 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

States in $^{202}$Hg have been studied with several techniques involving the (n,gamma) reaction at thermal and resonant neutron energies. Gamma ray spectra were recorded for primary and secondary transitions and in singles and coincidence modes. A level scheme comprised of 22 excited states and approximately 80 transitions was constructed. Comparison of these results with analogous results for $^{200}$Hg reveals important nuclear structure differences. (auth)

**13669** SPINS AND LIFETIMES OF NEW LOW-LYING STATES IN $^{204}$Tl. Rabenstein, D. (Technische Univ., Munich). pp 584-

588 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Eight new low-spin states below 1 MeV are proposed in $^{204}$Tl and their γ-decay is given. New γ-branchings have been found for those states which were already known. Tentative spin assignments for most of these low-lying states are given. The mean life of the new second excited state has been determined to be $\tau = 27 \pm 2$ ns. (3 figures) (auth)

**13670** MAGNETIC LENS ELECTRON SPECTROMETER WITH SIMULATIONS MOMENTUM AND ENERGY SELECTION. Julin, R.; Kantele, J.; Passoja, A. (Univ., Jyvaskyla, Finland). pp 706-708 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A preliminary version of a combined swept-current magnetic lens plus Si(Li) electron spectrometer with simultaneous momentum and energy selection is presented. Results from test runs indicate that the spectrometer will be featuring good energy resolution and line shape, moderate transmission, and low background. The spectrometer is intended to in-beam measurements of conversion electron lines up to several MeV in energy and to nanosecond lifetime determinations, as well as to off-line studies of continuous beta-ray spectra and conversion lines from short-lived activities. (auth)

**13671** RECOIL RANGES AND MASS YIELDS IN THE REACTOR-NEUTRON-INDUCED FISSION OF $^{232}$U. Manohar, S. B.; Prasanna Venkatesan, P.; Satya Prakash; Ramaniah, M. V. (Bhabha Atomic Research Centre, Bombay (India). Radiochemistry Div.). pp 183-190 of Proceedings of the Chemistry Symposium, Aligarh, December 21-23 1972. Vol. I. Radioisotope Techniques for Chemical and Biomedical Applications, Nuclear, and Radio Chemistry, and Radiation Chemistry. Bombay; Department of Atomic Energy (1974).

From chemistry symposium; Aligarh, India (21 Dec 1972). 8 refs., 2 tables, 1 figure.

The results of experiments on the determination of recoil ranges in Al and the mass yields in the reactor induced fission of $^{232}$U are reported. The thin target, thin catcher technique was employed in these investigations. The activities of the fission products formed were estimated by gamma-ray counting using Ge(Li) detector. The comparison method was used for mass yield determinations. The work reported here is limited to high yield asymmetric region only. The radiochemical studies in the symmetric region are in progress. (auth)

**13672** EXCITATION OF HIGH-SPIN STATES IN $^{190,191,192,193,194}$Hg THROUGH ($\alpha$,xn) REACTIONS. Lieder, R. M.; Beuscher, H.; Davidson, W. F.; Neskakis, A.; Mayer-Boericke, C. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Kernphysik). Nucl. Phys., A; 248: No. 2, 317-341(25 Aug 1975).

High spin states in $^{190,191,192,193,194}$Hg have been populated with ($\alpha$,xn) reactions and studied using in-beam γ-ray spectroscopy methods. Several new features have been observed in these nuclei. In the ground state bands of $^{190,192,194}$Hg, in addition to the low-spin states up to $8^+$, a sequence of high-spin states on top of the $10^+$ isomer (up to $18^+$ in $^{192,194}$Hg) was observed. The energy spacings of the new level sequences in $^{190,192,194}$Hg resemble very closely those observed for the low-lying members of the ground state bands up to $6^+$. The $10^+$ state has probably a $(\pi h_{11/2}^{-2})$ two-proton-hole configuration and the level sequence above the $10^+$ isomer has possibly a structure similar to the low-lying states of the ground state band. In $^{192,194}$Hg the even-spin members of the negative-parity bands with spins and parities $8^-$, $10^-$, $12^-$, ..., $18^-$ were established. These states are shifted upwards in energy with respect to the odd-spin members $5^-$, $7^-$, $9^-$, ..., in accordance with recent theoretical calculations. In $^{191,193}$Hg a level structure has been observed which compares remarkably well with the band structure of the neighboring even nuclei. This can be interpreted in the framework of the rotation-alignment model by Coriolis-decoupling of the extra $i_{13/2}$ neutron from the core. (auth)

**13673** NUCLEAR g FACTORS OF THE FIRST AND SECOND $2^+$ STATES IN $^{192,194}$Pt. Katayama, I.; Morinobu, S.; Ikegami, H. (Tokyo Inst. of Tech.). Hyperfine Interact.; 1: No. 2, 113-134(Aug 1975).

The g factors of the first and second excited $2^+$ states in $^{192}$Pt and $^{194}$Pt have been measured using γ-γ angular correlations perturbed by the hyperfine field in an iron lattice. Bulk magnetization of solutes were examined with special care for different shapes of alloys and different magnetizing conditions. The following results have been obtained: $^{192}$Pt: 316 keV state $g = 0.346 \pm 0.024$, 612 keV state $g = 0.455 \pm 0.089$, $^{194}$Pt: 328 keV state $g = 0.354 \pm 0.031$, 622 keV state $g = 0.316 \pm 0.029$. These values are the largest ones which have been reported so far. The discrepancies between the present and previous data are discussed especially in terms of magnetizing conditions for the sources used. It is suggested that the difference in g factor between the first and second $2^+$ states may be in a certain correlation with M1 matrix elements connecting these two states. (auth)

**13674** ROTATION-ALIGNED COUPLING AND AXIAL ASYMMETRY IN $^{189,195}$Au. Zganjar, E. F. (Louisiana State Univ., Baton Rouge (USA)); Wood, J. L.; Fink, R. W. (Georgia Inst. of Tech., Atlanta (USA). School of Chemistry); Riedinger, L. L.; Bingham, C. R. (Tennessee Univ., Knoxville (USA)); Kern, B. D.; Weil, J. L. (Kentucky Univ., Lexington (USA)); Hamilton, J. H.; Ramayya, A. V. (Vanderbilt Univ., Nashville, Tenn. (USA)); Spejewski, E. H. Phys. Lett., B; 58: No. 2, 159-162(1 Sep 1975).

Levels in $^{189,191,193}$Au have been studied by radioactive decay of isotopically separated $^{189,191,193}$Hg. The systematics of the levels are followed from $^{195}$Au to $^{189}$Au and show a remarkable insensitivity to neutron number. The $h_{9/2}$ bands are identified and provide a critical test of the model of a single-j nucleon subject to rotation-aligned coupling to an asymmetric core. Within the framework of the model the triaxial degree of freedom appears to be very stable. (NL)

**13675** COEXISTENCE OF OBLATE AND PROLATE FORMS IN $^{189}$Au. Deleplanque, M. A.; Gerschel, C.; Perrin, N.; Berg, V. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 249: No. 2, 366-378(15 Sep 1975). (In French).

Two decoupled bands are found in $^{189}$Au with the $^{181}$Ta($^{12}$C,4n)$^{189}$Au reaction. The first one, built on a $h_{9/2}$ state, implies an oblate deformation of the nucleus, while the second one, built on a $h_{9/2}$ state, corresponds to the doubly even core. (NL)

# Nuclear Properties and Reactions, A ≥ 220

*Refer also to abstracts 12082, 12174, 12780, 13580, and 13649.*

**13676** (ANL/NDM-16) FAST NEUTRON EXCITATION OF THE GROUND-STATE ROTATIONAL BAND OF $^{238}$U. Guenther, P.; Havel, D.; Smith, A. (Argonne National Lab., Ill. (USA)). Sep 1975. 55p. Dep. NTIS $5.50.

The differential neutron cross sections for the excitation of the 2+(45 keV), 4+(148 keV) and 6+(308 keV) states of $^{238}$U are measured for scattered neutron energies in the range 0.1 to 3.0 MeV. The observed excitation cross sections vary smoothly with energy with no significant fluctuations. The experimental results are correlated with the predictions of compound-nucleus and direct-reaction models. At lower energies (less than or approximately equal to 0.8 MeV) the observed inelastic scattering cross sections are consistent in shape and magnitude with the predictions of compound-nucleus theory. Above approximately or equal to 1.0 MeV comparison of measured and calculated values indicates large direct-reaction contributions. The experimental and computational results are compared with the evaluated nuclear data file, ENDF/B-IV, and significant discrepancies are noted. The present results and selected values from the literature are used to deduce an evaluated set of $^{238}$U inelastic scattering cross sections. 11 figures, 4 tables. (auth)

**13677** (CEA-N-1791, pp 195-196) $^{238}$U FISSION. Blons, J.; Mazur, C. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973-30 September 1974.

A measurement of the ratio of ($^{238}$U) was made with a resolution of 0.3 ns/m. Five class II-states were observed between 274 eV and 1974 eV with a mean spacing of 425 eV. Due to the good resolution in the 1 MeV region some resonance-like structures were seen between 0.6 and 1.2 MeV. (FR)

**13678** (CEA-N-1791, pp 197-198) SEARCH FOR A PRE-FISSION γ RADIATION. Pranal, Y.; Sukosd, C.; Trochon, J. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973-30 September 1974.

The γ-rays in $^{239}$Pu(n,γf) reaction were separated in view of understanding some discrepancies between experiments and calculations. The preliminary results fail in showing high energy

γ-rays corresponding to intermediate states in the second well of the fission barrier which had been put forward to explain the discrepancies. (FR)

**13679** (CEA-N-1791, pp 213-215) MEASUREMENT OF THE TOTAL ENERGY EMITTED AS PROMPT GAMMA RADIATION IN $^{252}$Cf SPONTANEOUS FISSION. Girard, J.; Nifenecker, H.; Ribrag, M. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The total energy of the prompt gamma-rays was measured with a 4π liquid Gd-loaded scintillator. The contribution of recoil protons due to the prompt neutrons has been determined from the measurement of the light response of the scintillator per proton relative to the light response per electron. This contribution is, in average, 0.45 MeV per fission neutron. The corrected γ-ray energy still shows a strong positive correlation to the prompt neutron number: the existence of an important gamma-neutron composition during the fragment deexcitation process is then confirmed. (FR)

**13680** (CEA-N-1791, pp 216-217) MEASUREMENT OF THE VARIATIONS IN THE AVERAGE TOTAL KINETIC ENERGY FOR FISSION FRAGMENTS AS A FUNCTION OF THE EXCITATION ENERGY OF THE FISSIONING SYSTEM. Mazur, C.; Paya, D.; Rao, B. V. N. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The variation of the average kinetic energy of the fission fragments in the $^{235}$U(α,f) reaction is investigated. (FR)

**13681** (CEA-N-1791, pp 217-218) MEASUREMENT OF THE ANGULAR DISTRIBUTION OF THE α PARTICLE IN TRIPARTITION AS A FUNCTION OF SCISSION MODE OF THE FISSIONING SYSTEM. Girard, J.; Ribrag, M.; Signarbieux, C. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

A multidimensional experiment on the tripartition process has been planned at Grenoble's High Flux reactor in order to measure in correlation the masses, velocities, directions of the two fragments and the α-particle. (FR)

**13682** (IFA-FT-106-1974) α DECAY OF $^{230}$Pu. Dumitrescu, O.; Petrascu, M.; Popescu, G. D.; Sandulescu, A. (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 12p. INIS.

The influence of the complex structure of the low-lying $^{230}$U-states on the corresponding α transitions is analyzed. The hindrance factors (HF) for seven rotational bands are computed. It is shown that the inclusion of the unfavored plus unfavored β-vibrational α transitions in addition to the favored plus favored β-vibrational α transitions improves considerably the agreement of the theory with the experiment. (auth)

**13683** (KURRI-TR-122, pp 2-6) STABILITY OF SUPERHEAVY NUCLEI. Yamada, M. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

Theory of super heavy nuclei was investigated. The types of decay of super heavy nuclei to be considered are αdecay, β decay and spontaneous fission. The stable or long-lived nuclei to β decay are expected among the super heavy nuclei. The deviation from mass formulae is seen for the mass of the nuclei with A ≳ 200. The half-life in the α decay is estimated from the Q value. A shell effect is expected from the calculation by many authors. The estimation of half-life in the spontaneous fission is very hard, and is a problem to be studied. Previous papers calculated by considering the potential of modified shell model, calculation of a single particle level, smoothing by Strutinsky method, assumption of liquid drop, determination by WKB method, taking adiabatic potential, and calculation of effective mass extrapolated from actinide nuclei. Various comments are presented for this calculation. The author describes a new phenomenological theory. Since it is hard to know directly the process of nuclear fission, smooth interpolation from the information before and after the fission is applied. A parameter d, which is the interval between two fragments of fission, can be adjusted to fit the half-life of spontaneous fission. The values of d obtained for $^{238}$U, $^{240}$Pu and $^{252}$Cf were about 2.5fm and almost same values. The second step of the calculation, in which the shell correction in the energy and deformation of parent nuclei are taken into consideration, is in progress. (JA)

**13684** (KURRI-TR-122, pp 15-17) GAMMA-PROCESS. Ohnishi, T. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

The γ-process was extended to the domain of A ≫ 200 by using Myers-Swiatecki's formula. The maximum mass number of the atomic nuclei produced in the process of neutron absorption can be estimated from predicted magic numbers. The formation of nuclei with A ≳ 350 is impossible in the range of neutron density considered as the condition for the γ-process. The amount of production of nuclei in the r-process is shown in a figure. Peaks are seen at the mass numbers of 200, 280, and 340 which correspond to the neutron magic numbers 128, 184, and 228 (+Z = 114). The stabilization of r-process nuclei can be made by reaching β-stability line after successive β decay. However, the effect of spontaneous fission cannot be ignored. The probability σt of the stabilization through β decay is unity for A ≲ 245, and nearly zero for 255 ≲ A ≲ 265, 320 ≲ A ≲ 330, 355 ≲ A. For mass number regions 275 ≲ A ≲ 285, and 340 ≲ A ≲ 355, the probability σt is larger than $10^{-1}$. These two regions correspond to neutron magic numbers. The amount of γ-process nuclei on the stability line can be obtained by using these σt. (auth)

**13685** (KURRI-TR-122, pp 43-51) SYNTHESIS REACTION OF SUPERHEAVY NUCLEI. Imanishi, N. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

Estimation of the cross-section of synthesis of superheavy nuclei was carried out. The items taken into account for complete fusion cross-section were large Coulomb barrier, the deformation of nuclei at the moment of collision and change of the barrier, large angular momentum, the limit value of collision parameter, the limit of angular momentum which can be carried in, shell effect and the limit of excitation energy. Since it is necessary to avoid fission in the process of formation, fusion must be made in cold state and with Coulomb barrier as low as possible. The upper limit of angular momentum which could be carried in was estimated. The fusion cross-section limited by critical angular momentum was calculated, and shown in figures. The values of the cross-section are about 10 mb for $^{48}$Ca + $^{248}$Cm, 5 mb for $^{76}$Ge + $^{232}$Th, and 3 mb for $^{86}$Kr + $^{232}$Th. Competition of neutron emission from compound nuclei with spontaneous fission is discussed. The ratio of neutron emission width to fission width Γn/Γf depends on the height of Coulomb barrier and neutron binding energy. (JA)

**13686** (KURRI-TR-122, pp 55-59) POSSIBILITY OF FORMATION OF SUPERHEAVY NUCLEI BY HEAVY ION REACTION. Baba, H. [nd]. (In Japanese)

From study meeting on heavy nuclides and superheavy nuclides; Kumatori, Osaka, Japan (18 Sep 1972).

In proceedings of the study meeting on heavy nuclides and superheavy nuclides.

The possibility of the formation of superheavy nuclei by heavy ion reactions was investigated. The classical treatment of calculation can be made for the heavy ion reaction in the usual energy range. The angular momentum carried into compound nuclei at the time of impact is large. The maximum orbital angular momentum can be obtained with a sharp cut-off model. The cross-section of the heavy ion reaction is estimated by a black nucleus approximation. This approximation can explain experimental results such as $^{197}$Au + $^{16}$O and others. The calculated cross-section for two reactions $^{232}$Th + $^{76}$Ge and $^{252}$Cf + $^{48}$Ca was obtained and shown in figures together with maximum angular momentum. Large angular momentum hinders the formation of compound nuclei. The limit angular momentum at which nuclei lose stability against nuclear fission was calculated, and about 100 for actinide nuclei. If the stability of superheavy nuclei is same as the actinide nuclei with the help of shell effect, the maximum angular momentum seems to be also ~100. However, the shell effect disappears in the case of the formation of superheavy elements in highly excited states, and the value of the angular momentum is reduced. As kinetic energy increases, the maximum angular momentum exceeds the critical angular momentum, and the cross-section stops to increase. The reducing factor is nearly 0 for $^{232}$Th + $^{76}$Ge and about $10^{-2}$ for $^{252}$Cf + $^{48}$Ca. Neutron emission and spontaneous fission after the formation of compound nuclei are discussed. As a result, the possibility of the synthesis of superheavy nuclei by using above mentioned reactions is very small. (JA)

**13687** (TID-3317(Suppl.6)) TRANSPLUTONIUM ELEMENTS. A Bibliography. Stuber, C. E. (Energy Research and Development Administration, Oak Ridge, Tenn. (USA). Technical Information Center). Nov 1975. 242p. Dep. NTIS $7.60.

This bibliography, prepared especially for distribution at the IAEA/ERDA International Symposium on the Transuranium Nuclides in the Environment, San Francisco, November 17-21, 1975, comprises 589 references on the transplutonium elements compiled through the period January 1 to October 15, 1975. The references were retrieved from the Nuclear Science Abstracts (NSA) data base using a computerized information retrieval system and were formatted for publication with indexes by computer. Part I includes 565 references dealing with the production and chemical, nuclear, physical, and biological properties and health, safety, and environmental aspects of elements with Z greater than or equal to 95. Part II includes 24 references dealing with the natural occurrence of the transplutonium elements. This collection of references is concerned with attempts to locate or prove the existence of the transplutonium elements in nature. Part III, a feature added to enhance the usefulness of this bibliography to the participants at this symposium, contains 772 references on the environmental aspects of neptunium and plutonium retrieved from NSA through the period June 1, 1973 through October 15, 1975. Author, report number, and subject indexes are included. (auth)

**13688** (UCID-16981) FISSION CROSS SECTION RATIO OF $^{239}$Pu TO $^{235}$U FROM 0.1 TO 30 MeV. Carlson, G. W.; Behrens, J. W. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 15 Dec 1975. Contract W-7405-Eng-48. 9p. Dep. NTIS $4.50.

Results are given for the neutron-induced fission cross section ratio of $^{239}$Pu to $^{235}$U in the neutron energy range 0.1 to 30 MeV. These data were normalized with an estimated total uncertainty of +-2 percent using the threshold cross section method. Work still in progress includes a normalization at thermal neutron energy. A more detailed discussion of our measurements will be presented upon completion of this work. A table of the present cross section ratio data is included. (auth)

**13689** PION CONDENSATION IN HIGH ENERGY HEAVY-ION COLLISIONS. Kitazoe, Y.; Sano, M. (Univ., Osaka). Lett. Nuovo Cim.; 14: No. 11, 400-406(15 Nov 1975).

The effect of pion condensation on the formation of the high density nuclear matter is discussed by taking into account the relativistic and quantum mechanical effects which were not considered previously. The head-on collisions of two identical heavy nuclei are considered. The temperature dependence of various functions is plotted. (JFP)

**13690** ANGULAR DISTRIBUTIONS OF EJECTED PARTICLES IN HIGH ENERGY HEAVY-ION COLLISIONS. Kitazoe, Y.; Sano, M. (Univ., Osaka). Lett. Nuovo Cim.; 14: No. 11, 407-412(15 Nov 1975).

It is reported that the hydrodynamical approach developed in previous work can explain the energy dependence of the peak positions in the angular distributions of ejected particles as a support of formation of high density nuclear matter. It is also shown by performing numerical calculations that the effect of pion condensation proposed previously plays a significant role in explaining the experimental behavior of the peak position at E = 0.25 GeV/N. (JFP)

**13691** GIANT MULTIPOLE RESONANCES IN $^{208}$Pb. Grecksch, E.; Knuepfer, W.; Huber, M. G. (Univ., Erlangen, Ger.). Lett. Nuovo Cim.; 14: No. 14, 505-510(6 Dec 1975).

A consistent calculation of the low energy spectrum and the giant multipole resonance is presented for lead-208 in the model of separable residual interaction. In this model a very simple parametrization of the effective interaction was used which exhibits directly the influence of the restricted configuration space on the force. (auth)

**13692** EXPERIMENTS WITH ORIENTED NUCLEI AND LOW-ENERGY NEUTRONS. Postma, H. (Rijksuniversiteit, Groningen, Netherlands). pp 619-637 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The application of nuclear orientation in the study of low-energy neutron reactions is discussed. Several types of experiments pass in review, namely: the determination of resonance spins with the aid of polarized neutrons on polarized nuclei, gamma-ray emission from oriented nuclei after neutron capture, which gives information about spins of intermediate levels, and fission of aligned nuclei. The latter type of experiment reveals information about the K-quantum number of fission channels. (57 references) (auth)

**13693** CONTRIBUTED PAPERS ON PROPERTIES OF HEAVY NUCLEI (A > 208). Weigmann, H. (CBNM, Geel, Belgium). pp 645-654 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Five contributed papers are presented which describe neutron capture studies of actinide nuclei. (9 figures) (auth)

**13694** ODD PLUTONIUM ISOTOPES BY THERMAL NEUTRON CAPTURE. Matussek, P. (Institut fuer Angewandte Kernphysik, Karlsruhe, Ger.). pp 655-657 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Thermal neutron capture $\gamma$-ray measurements have been performed on $^{239}$Pu and $^{241}$Pu in the energy range from about 300 keV to 6 MeV. Preliminary level schemes based on primary transitions and the most intense secondary $\gamma$-rays are given. Neutron binding energies have been determined as 5647.0 ± 0.5 keV and 5241.3 ± 0.7 keV for $^{239}$Pu and $^{241}$Pu, respectively. (auth)

**13695** RADIATIVE CAPTURE OF THERMAL AND EPITHERMAL NEUTRONS IN $^{235}$U. Ottmar, H.; Matussek, P.; Piper, I. (Institut fuer Angewandte Kernphysik, Karlsruhe, Ger.). pp 658-664 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The level structure of $^{236}$U has been studied using radiative capture of both thermal and 2 keV neutrons in $^{235}$U and the $\alpha$-decay of $^{240}$Pu. The detection of primary $\gamma$-rays as well as coincident low-energy $\gamma$-rays from thermal neutron capture was possible by using different techniques for the suppression of competing $\gamma$-rays from the fission process. Average intensities for E1 transitions leaving the capture state were obtained from an average resonance-capture spectrum measured in a 2 keV neutron beam. (auth)

**13696** GAMMA-RAY TRANSITIONS PRECEDING ISOMERIC FISSION IN $^{236}$U. Loebner, K. E. G. (Technische Univ., Munich); Harrach, D.; Konecny, E.; Nenoff, N.; Specht, H. J.; Weber, J. pp 665-669 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Delayed coincidences between gamma-rays and fission fragments have been measured for 47 days to detect gamma-ray transitions preceding the isomeric fission of $^{236}$U after thermal neutron capture in $^{235}$U. A doublet of gamma rays at 699.6 keV and a gamma-ray line at 718.0 keV have been observed. Their intensities correspond to a relative intensity of $\approx 10^{-4}$ per prompt fission event. (auth)

**13697** RESONANCE CAPTURE GAMMA-RAY SPECTRA OF $^{240}$Pu. Thomas, B. W. (United Kingdom Atomic Energy Research Authority, Harwell, Eng); Haste, T. J. pp 670-672 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The intensities of primary gamma-rays (2.5 - 5.0 MeV) have been measured for several resonances in the $^{240}$Pu(n,$\gamma$) reaction. The final states populated are compared with those observed by (d,p) experiments and are consistent with a neutron binding energy of 5241 ± 4 keV. Unusual features of the data are a strong correlation between three transitions in the resonances below 104 eV, and exceptionally strong transitions to low lying states in unresolved resonances at energies of the subthreshold fission groups. (auth)

**13698** NEUTRON RESONANCE CAPTURE INVESTIGATIONS AS A MEANS OF STUDYING THE COUPLING CONDITIONS IN SUB-BARRIER FISSION. Weigmann, H. (CBNM, Geel, Belgium); Rohr, G.; van der Veen, T.; Vanpraet, G. pp 673-678 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Neutron resonance capture in $^{237}$Np and $^{238}$U has been studied at resonances which show enhanced fission due to coupling to states associated with the secondary minimum of the deformation energy. No anomality has been found in the gross shape of the

γ-ray spectra from these resonances. From this fact, conclusions are drawn with respect to the coupling conditions in subbarrier fission which are compared to the information available from other experimental sources. (auth)

**13699** APPLICATIONS OF NEUTRON CAPTURE γ-RAY SPECTROSCOPY. Bowman, C. D. (National Bureau of Standards, Washington, DC). pp 729-734 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Applications such as materials analysis, radiation shielding design, measurement of capture cross sections required in nuclear core design and in problems in astrophysics, and the development of fission reactors are discussed. The neutron source problem is also considered. An attempt is made to examine the basic science for insights into applications of the future. (BJG)

**13700** ERROR CALCULATION OF CAPTURE CROSS-SECTIONS FOR FISSION PRODUCT NUCLEI. Gruppelaar, H. (Reactor Centrum Nederland, Petten). pp 760-766 of Neutron Capture Gamma-Ray Spectrosocpy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The error analysis of capture cross-sections for fission product nuclei is of interest for the prediction of uncertainties in fast breeder reactor parameters and the evaluation of results of integral cross-section measurements. This paper comments and extends some earlier published reports on the subject. The following types of statistical errors in the radiative capture cross-sections as calculated with the statistical model are considered: errors due to uncertainties in phenomenological parameters; errors due to uncertainties in the level scheme of the target nucleus; errors due to fluctuations in the number of bound levels; errors due to fluctuating level widths; and errors due to fluctuations in the number of resonances per averaging interval. (16 references) (auth)

**13701** $^{234}$U LEVELS FED IN THE β DECAY OF $^{234}$Pa (UZ). Ardisson, G.; Ardisson, C. (Algiers Univ. (Algeria). Faculte des Sciences). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 12, 377-379(24 Mar 1975). (In French).

The radioactive decay of $^{234}$Pa (UZ) was reinvestigated; a great number of γ transitions following this decay was interpreted in a $^{234}$U level scheme. A 1,693.7keV level ($K^{\pi} = 5^{-}$) was confirmed. New levels are suggested at 1,736.9, 1,811.5, 1,881.4 and 2,144.1keV. (FR)

**13702** ABSOLUTE MEASUREMENTS OF RADIATIVE CAPTURE CROSS SECTION FOR 30-keV NEUTRONS IN URANIUM-238. Panitkin, Yu. G.; Sherman, L. E. At. Energ. (USSR); 39: No. 1, 17-19(Jul 1975). (In Russian).

The capture cross section for 30-keV neutrons in uranium-238 has been measured absolutely using kinematically collimated neutrons from the $^{7}$Li(p,n)$^{7}$Be reaction near threshold. Activation techniques were used to determine the number of capture events and the neutron flux. The neutron flux was determined from the associated activity of the $^{7}$Li(p,n)$^{7}$Be neutron source reaction. The result of the uranium-238 capture cross section measurements is 465 ± 23 mb for 30-keV neutrons. This result was used to normalize the cross sections measured earlier and is compared with the results of other authors. (2 figures, 2 tables, 20 references ) (auth)

**13703** WAVE FUNCTIONS OF NUCLEAR STATES WITH SMALL SINGLE-PARTICLE SPECTROSCOPIC FACTORS. Bernhardt, K. G.; Hering, W. R. (Muenchen Univ. (F. R. Germany). Sektion Physik); Ring, P. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.); Werner, E. (Technische Univ. Hannover (F.R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 249: No. 2, 329-348(15 Sep 1975).

The reactions $^{208}$Pb(d,p)$^{209}$Pb and $^{208}$Pb(p,d)$^{207}$Pb leading to fragmented single-particle states in the final nuclei have been analyzed by using microscopically calculated bound state wave functions. Considerable deviations between these results and those of the conventional well depth procedure occur and are traced back to non-localities in the potential associated with the single-particle component of the bound state wave function which are caused by the mixing of the single-particle and excited-core configurations. Consequences for the determination of spectroscopic factors and the application of sum rules are discussed. (NL)

**13704** GEOMETRICAL AND DYNAMICAL STATE OF THE $^{252}$Cf NUCLEUS AT THE SCISSION POINT AS DETERMINED FROM THE EXPERIMENTAL RESULTS OF TERNARY FISSION. Fossati, F.; Pinelli, T. (Pavia Univ. (Italy). Instituto di Fisica). Nucl. Phys., A; 249: No. 1, 185-204(8 Sep 1975).

Results on the geometrical and dynamical states of fission fragments and α-particles are presented for the most probable mode of ternary fission, at the instant of release of the light particle. The distributions of the relevant physical quantities are obtained by means of a program calculating the trajectories of three point charges. A total of about $2 \times 10^{5}$ combinations of the parameters, derived by subdividing the quantities into physically significant intervals, are used. The computed values are compared with experimental results and the distributions of the parameters are weighted by the spectrum of the α-particles. The dynamics of the system undergoing fission at scission point are characterized by the following quantities: (i) The total kinetic energy of fragments. (ii) The kinetic energy of the α-particle. (iii) The distance between centers of charge of the fragments. (iv) The abscissa and ordinate of the α-particle emission point. (v) The emission angle of the α-particle with respect to the line of flight of the light fragment. The distributions of above quantities are presented for the most probable model of spontaneous ternary fission of $^{252}$Cf. The results obtained are discussed and relevant information on the dynamical properties of the last fission stage is presented. (NL)

**13705** NUCLEAR STRUCTURE STUDY OF THE β-DECAY OF $^{210}$Bi (RaE). Ebert, K.; Wild, W. (Technische Univ. Muenchen, Garching (F.R. Germany). Physik-Dept.); Krmpotic, F. (La Plata Univ. Nacional (Argentina). Departamento de Fisica). Phys. Lett., B; 58: No. 2, 132-134(1 Sep 1975).

The β-moments for the $^{210}$Bi → $^{210}$Po transition are calculated in the framework of the theory of Finite Fermi Systems using a density-dependent residual interaction. There is fair agreement with the phenomenological moments. The remaining discrepancies are displayed. (NL)

**13706** EVALUATION OF NEUTRON INELASTIC SCATTERING CROSS SECTIONS OF URANIUM-238 FROM NEUTRON SPECTRUM MEASUREMENTS IN FAST MEDIA. Corcuera, R. P. (Centre d'Etudes Nucleaires de Cadarache, Saint Paul-lez-Durance, France). Nucl. Sci. Eng.; 58: No. 3, 278-290(Nov 1975).

Systematic discrepancies between experimental and calculated neutron spectra in different fast-neutron media with high $^{238}$U content were observed, allowing the uncertainties in certain $^{238}$U neutron cross sections to be considered as the source of such discrepancies. Sensitivity studies, as well as the effect of the former uncertainties on such fast-neutron spectra showed that $^{238}$U (n,n') inelastic scattering is by far the main parameter determining the spectrum over a large energy range. Uranium-238 (n,gamma) neutron capture is important only at low energies, below the $^{238}$U (n,n') threshold. The (n,gamma n') reaction in $^{238}$U using Fricke's data leads to an increase in the discrepancies in neutron spectra though this cross section could be considered negligible according to other arguments. A general least-squares adjustment of the $^{238}$U total inelastic cross sections, on the neutron spectrum discrepancies, was carried out between 70 keV and 3.6 MeV, using two different inelastic probability matrices (those of ENDF/B-III and UKNDL-DFN 401), which were chosen among several evaluations of this reaction. The adjusted cross sections obtained in an energy mesh corresponding to lethargy intervals of 0.5 imply a systematic reduction of 20 to 30 percent relative to the initial values in both files, but they appear to be in good agreement with other recent (coarse-mesh) adjusted data, including the KFK-INR set. (15 tables) (auth)

## Nuclear Theory

*Refer also to abstracts 13325, 13442, 13516, 13666, 13689, and 13835.*

**13707** (AECL-5226, pp 17-18) DOES THE CABIBBO ANGLE SOMETIMES VANISH IN NUCLEAR BETA-DECAY? Hardy, J. C.; Towner, I. S. Aug 1975.

In Physics Division progress report, April 1-June 30, 1975.

**13708** (CEA-N-1791, pp 183-184) PROGRAM FOR DATA ACQUISITION AND ON-LINE PROCESSING FOR (e,e'p) EXPERIMENTS. Auriol, E.; Bernheim, M.; Bussiere, A.; Gillebert, A.; Mougey, J.; Royer, D. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973-30 September 1974.

The data acquisition program for (e,e'p) experiments is described. (FR)

**13709** (INR-1455/7/PL/B) SINGLE PARTICLE NILSSON LEVELS. Numerical Program. Nerlo Pomorska, B. (Institute

of Nuclear Research, Warsaw (Poland)). 1973. 31p. (In Polish). INIS.

The program is written in language FORTRAN IV for CDC 3170 computer. It enables to calculate the single particle energetic levels of axially deformed potentials. The matrix elements of hamiltonian between different harmonic oscillator shells can be taken into account. (auth)

**13710** (JINR-E7-9148) SYNTHESIS OF NEW ELEMENTS WITHIN THE FRAGMENTATION THEORY: APPLICATION Z = 104 AND 106 ELEMENTS. Sandulescu, A.; Gupta, R. K.; Scheid, W.; Greiner, W. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1975. 17p. Dep. NTIS (US Sales Only) $4.50.

From a new point of view, the fragmentation theory is used to select out the projectile and target nuclei for the production of superheavy elements. It is suggested to choose the partners of a reaction corresponding to the minima in the potential energy, calculated as a function of the mass and charge asymmetry coordinates. The theory is supported by the experiments already carried out, and also new experiments are suggested. (auth)

**13711** (ORNL-TM-5174) INVERSION OF SINGLE-PARTICLE LEVELS IN NUCLEAR HARTREE-FOCK AND BRUECKNER-HF CALCULATIONS WITH BROKEN SYMMETRY. Becker, R. L.; Svenne, J. P. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 49p. Dep. NTIS $5.45.

Energy levels of states connected by a symmetry of the Hamiltonian normally should be degenerate. In self-consistent field theories, when only one of a pair of single-particle levels connected by a symmetry of the full Hamiltonian is occupied, the degeneracy is split and the unoccupied level often lies below the occupied one. Inversions of neutron-proton (charge) and time-reversal doublets in odd nuclei, charge doublets in even nuclei with a neutron excess, and spin-orbit doublets in spherical configurations with spin-unsaturated shells are examined. The origin of the level inversion is investigated, and the following explanation offered. Unoccupied single-particle levels, from a calculation in an A-particle system, should be interpreted as levels of the (A + 1)-particle system. When the symmetry-related level, occupied in the A-particle system, is also calculated in the (A + 1)-particle system it is degenerate with or lies lower than the other. That is, when both levels are calculated in the (A + 1)-particle system, they are not inverted. It is demonstrated that the usual prescription to occupy the lowest-lying orbitals should be modified to refer to the single-particle energies calculated in the (A + 1)- or the (A - 1)-particle system. This observation is shown to provide a justification for avoiding an oscillation of occupancy between symmetry-related partners in successive iterations leading to a self-consistency. It is pointed out that two degenerate determinants arise from occupying one or the other partner of an initially degenerate pair of levels and then iterating to self-consistency. The existence of the degenerate determinants indicates the need for introducing correlations, either by mixing the two configurations or by allowing additional symmetry-breaking (resulting in a more highly deformed non-degenerate configuration). 2 figures, 3 tables, 43 references. (auth)

**13712** (ORO-4856-3) COLLIDING HEAVY IONS: NUCLEI AS DYNAMICAL FLUIDS. Griffin, J. J.; Kan, K. K. (Maryland Univ., College Park (USA). Dept. of Physics and Astronomy). Sep 1975. 41p. (CONF-7410143-1). Dep. NTIS $5.00.

From meeting of the American Physical Society; Pittsburgh, Pennsylvania, USA (31 Oct 1974).

Heavy ion experiments are already enriching nuclear science with a tapestry of new phenomena which demand explanation. In response, theoretical nuclear physics is rapidly expanding its insights to encompass these new observations, especially those concerned with the macroscopic aspects. Preliminary theoretical studies already suggest that the dynamical nuclear fluid must sometimes be considered viscous, compressible, and/or rotational if its microscopic properties are to be encompassed. These and some threads already well placed in the picture will be discussed. Other reasons will be cited to support the expectation that theoretical nuclear macroscopists may more and more come to be fluid dynamicists who specialize in those few thousand fluids called nuclei. Three such reasons are (a) the promised richness of their structure as dynamical fluids, (b) their unique prospect, among all the objects of modern physical science, of allowing complete microscopic, as well as phenomenological macroscopic, descriptions and (c) the possible overflow of such nuclear implications into classical fluid theory, from the viewpoint of which the nuclear heavy ion data are a significant novelty. 24 figures. (auth)

**13713** (RLO-1388-294) CHARGE DEPENDENT MIXING. Adelberger, E. G. (Washington Univ., Seattle (USA). Nuclear Physics Lab.). 1975. 21p. (CONF-7409138-1). Dep. NTIS $4.50.

From conference on nuclear physics; Amsterdam, Netherlands (Sep 1974).

A few issues relating to charge dependent (CD) mixing in light nuclei are discussed, emphasizing recent progress and attempting to provide a critical assessment of what has been learned. The main topics include the effect of CD distortion on beta, gamma, and particle reaction rates involving low lying states, isospin mixing in $^{8}$Be and $^{12}$C, and isospin mixing in T equals $\frac{3}{2}$ states. 14 figures. (SDF)

**13714** SURFACE DISTRIBUTIONS OF ALPHA PARTICLES IN HEAVY NUCLEI. Osman, A. (Univ., Cairo). Lett. Nuovo Cim.; 14: No. 11, 413-417(15 Nov 1975).

Three-particle scattering processes previously suggested for the case of three free $\alpha$ particles are extended to any three separated free particles. One is interested in nuclear reactions between heavy ions. Those reactions are considered in which an incident ion, has sufficient energy that $\alpha$ particles can be knocked out from the heavy target nucleus. Thus one gets in the final channel three free particles, namely the incident heavy ion, the emitted $\alpha$ particle, and a heavy nucleus. This heavy-ion reaction, namely the knock-out of an $\alpha$ particle from a heavy target nucleus by a heavy ion, presents considerable interest. It is concluded that nucleons on the surface of heavy nuclei tend to form $\alpha$ clusters. (JFP)

**13715** EVIDENCE OF NARROW SURFACE ABSORPTION FROM THE OPTICAL MODEL STUDIES OF S- AND P-WAVE STRENGTH FUNCTIONS. Jain, A. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique Nucleaire). J. Phys. (Paris); 36: No. 5, 335-341 (May 1975).

The effect of the width of the surface absorption potential in the spherical and deformed optical model is analysed with a view to explaining the long standing anomaly of the S-wave strength functions near A approximately 100. A reduction in the value of the width parameter b by a factor of two from that conventionally used has been able to explain the entire data, from A = 40 to 250, for S and P-wave strength functions and the radius parameter R'. The value 1.35 fm for $r_0$, in the radius formula $R = r_0 A^{\frac{1}{3}}$, has been found to give a satisfactory fit to the S-wave data. The $A^{\frac{1}{3}}$ power law for radii is found to be sufficient when vibrational-rotational model is used. (FR)

**13716** ABNORMAL NUCLEAR STATES AND VACUUM EXCITATIONS. Lee, T. D. (Columbia Univ., New York). pp 696-718 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The structure of the vacuum is examined assuming the existence of a strongly interacting neutral spin-0 even-parity meson or resonance. Abnormal nuclear states, the sigma model, and pure vacuum excitation are considered. (JFP)

**13717** SHORT-RANGE CORRELATIONS IN NUCLEAR MATTER. Hansen, O. K. (CERN, Geneva). pp 840-886 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

The treatment of short-range correlations in nuclear matter includes the trivial correlations which are the center-of-mass and Pauli correlations. Also a description is given of multiple scattering in which it is shown how correlations enter into the Glauber formalism. (JFP)

**13718** OPTICAL POTENTIAL AND NUCLEAR STRUCTURE. Sinha, B. (King's Coll., London (UK). Wheatstone Physics Lab.). Phys. Rep.; 20: No. 1, 1-57(Aug 1975).

The optical potential for single and composite particle projectiles has been derived and discussed in detail for incident energy range $25 \leq E \leq 90$ MeV. The real central part has been calculated by folding an effective two-body interaction with the nucleonic density distribution. The importance of using an effective interaction with the correct saturation properties has been emphasized and discussed in detail. The possibility of identifying the optical potential as a Hartree-Fock single particle potential has also been explored. The imaginary potential has been discussed both from a second-order perturbation formalism and a simple forward-scattering amplitude approximation. The utility of the later approach for straightforward data fitting has been discussed in detail. Using the Blin-Stoyle prescription of the spin-orbit potential a three parameter optical model has been developed. Such models have been extended for inelastic scattering, composite particle scattering and heavy-ion scattering. (auth)

**13719** SYSTEMATICS OF THE $1i_{13/2}$ SINGLE-PARTICLE LEVEL IN THE N = 83 ISOTONES. Heyde, K.; Waroquier, M.;

Vincx, H. (Ghent Rijksuniversiteit (Belgium)). Phys. Lett., B; 57: No. 5, 429-432(4 Aug 1975).

Unified model calculations can account for the strong splitting of the $1i_{13/2}$ neutron single-particle state as observed in the N = 83 isotones. Also, the half-life of the first $^{13/2}+$ level is accounted for in these calculations and indicates a coherent effect between the single-particle $1i_{13/2} \rightarrow 2f_{7/2}$ and collective E3 transitions. (auth)

**13720** MASS PARAMETERS FOR QUADRUPOLE VIBRATIONS IN THE ADIABATIC APPROXIMATION. Vautherin, D. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). Phys. Lett., B; 57: No. 5, 425-428(4 Aug 1975).

Nuclear quadrupole vibrations are investigated in the framework of the adiabatic time-dependent Hartree-Fock equations. Using a continuity condition satisfied by these equations, it is shown that a simple analytic expression can be derived for the mass parameter in the case where the collective variable $\alpha$ is a scaling variable i.e. changes the cartesian coordinates x, y, z into $x/\alpha$, $y/\alpha$, $\alpha^2 z$. This result depends only on the existence of the continuity equation and thus holds for any nucleon-nucleon interaction. Applications are considered in the case of small amplitude motion in oxygen-16 and calcium-40. (auth)

**13721** A COMPUTER PROGRAM FOR INTERNAL CONVERSION COEFFICIENTS AND PARTICLE PARAMETERS. Pauli, H. C. (Max-Planck-Institut fuer Kernphysik, Heidelberg, (F. R. Germany)); Raff, U. (Basel Univ. (Switzerland). Physikalisches Inst.). Comput. Phys. Commun.; 9: No. 6, 392-407(Jun 1975).

CATAR calculates internal conversion coefficients and particle parameters for electric and magnetic multipole transitions. The dynamic effects describing the interaction of the shell electrons with the nuclear charge and currents give rise to additional transition matrix elements (penetration matrix elements) through which the internal conversion process depends on the structure of the nucleus. The electric monopole (E0) internal conversion transition that is the most important penetration effect is also taken into account. The Dirac equation is solved numerically for the bound and the free electron states in a central field with a Hartree-Fock-Slater screening function given by input. The radial matrix elements for electric and magnetic multipole transitions are calculated simultaneously for all multipole orders and partial waves allowed by selection rules for each transition energy and atomic subshell. (auth)

**13722** THEORY OF COLLECTIVE MOTION IN A NUCLEUS WITH CONSIDERATION OF VORTEX MOTION OF NUCLEAR MATTER. Nevzglyadov, V. G. (Leningrad State Univ.). Dokl. Akad. Nauk SSSR; 221: No. 4, 805-808(1 Apr 1975). (In Russian).

**13723** INELASTIC RESCATTERING AND HIGH-ENERGY REACTIONS ON NUCLEI. Schwimmer, A. (California Inst. of Tech., Pasadena (USA)). Nucl. Phys., B; 94: No. 3, 445-459 (18 Aug 1975).

The inelastic rescattering contributions to the elastic amplitude average multiplicity and correlation parameters are calculated in particle-nucleus scattering for heavy nuclei at high energies. The results reproduce the general fratures of the experimental data. Possible corrections and the relation to other models are discussed. (auth)

**13724** EFFECT OF PERIODIC PERTURBATION ON SPONTANEOUS DECAY. Sen Gupta, N. D. (Tata Inst. of Fundamental Research, Bombay). Acta Phys. Acad. Sci. Hung.; 38: No. 3, 201-208(1975).

Time-dependent perturbation theory has been developed without any secular term in case of hermitian Hamiltonians. But the method can be easily extended for Hamiltonians which are not hermitian as in the problems of spontaneous decay. The nature of the Hamiltonian responsible for the decay and the nature of the solution of the Schrödinger equation with periodic perturbation are discussed. The solution of the Schrödinger equation with the decay operator and an external periodic perturbation is then obtained. The last section is a discussion on the effect of the periodic perturbation on the decay rates. (auth)

**13725** THEORY OF NON-ADIABATIC CRANKING AND NUCLEAR COLLECTIVE MOTION. Liran, S.; Scheefer, H. J.; Scheid, W.; Greiner, W. (Frankfurt Univ. (F. R. Germany). Inst. fuer Theoretische Physik). Nucl. Phys., A; 248: No. 2, 191-213 (25 Aug 1975).

The cranking model is extended to the case of a general non-adiabatic motion. The time-dependent many-body Schrödinger equation is solved, where the time dependence of the collective motion is determined by the classical Lagrange equations of motion. The Lagrangian is obtained from the expectation value of the energy. In the case of one collective degree of freedom the condition that the expectation value of the energy is constant in time is sufficient to determine the collective motion. An iteration procedure is applied, of which the zeroth order is shown to be the common cranking formula. In an alternative approach the energy conservation is expressed in differential form. This leads in the case of one collective degree of freedom to a set of coupled, non-linear first-order differential equations in time for the expansion coefficients of the many-body wave function and for the collective variable. As an illustrative example the case of two coupled linear harmonic oscillators is solved. (auth)

**13726** MODIFICATION OF THE BOHR-SOMMERFELD QUANTIZATION CONDITION. Marinov, M. S.; Popov, V. S. (Moscow Inst. of Theoretical Physics). J. Phys., A (London); 8: No. 10, 1575-1585(Oct 1975).

The Bohr-Sommerfeld quasiclassical quantization condition for a central potential is modified in such a way that the constant $\gamma$ becomes dependent on the angular momentum l and on the potential behavior at small distances. This form of the quantization condition is especially simple in the case l = 0. When applied to some particular potentials, taken as examples, the present approximation provides more accurate values of the level energies than the conventional form of the quantization condition. Application of the quasiclassical approach to singular potentials with "collapse" and to the superstrong Coulomb field induced by a charge Z > 137 is also considered. (auth)

**13727** RELATIONSHIP BETWEEN COHERENT STATES AND INTELLIGENT STATES AS APPLIED TO SPINS. Kolodziejczyk, L. (Lodz Univ., Poland). J. Phys., A (London); 8: No. 10, L99-L101(Oct 1975).

This letter shows that coherent states as defined by Mikhailov (Teor. Mat. Fiz.; 15: 367 (1973)), may be considered in certain special cases as intelligent states. (auth)

**13728** SATURATING EFFECT OF THE $\Delta(1236)$ IN NUCLEAR MATTER. Green, A. M.; Niskanen, J. A. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Nucl. Phys., A; 249: No. 3, 493-509(22 Sep 1975).

It is shown that the explicit introduction of the $\Delta(1236)$ into the two-nucleon interaction gives rise in nuclear matter to a repulsive contribution to the binding energy of 5 MeV per particle at $k_F = 1.4$ fm$^{-1}$. This contribution increases approximately as the square of the density. The effect is found using both the Pandharipande and Brueckner approaches with quantitative agreement between the two. A brief discussion is made of the compensating three-body force contribution. (NL)

**13729** LONG-RANGE EFFECTS IN THE EFFECTIVE NEUTRON-PROTON INTERACTION IN ODD-ODD DEFORMED NUCLEI. Boisson, J. P.; Piepenbring, R. (Grenoble-1 Univ., 38 (France). Inst. des Sciences Nucleaires); Ogle, W. (Nordisk Inst. for Teoretisk Atomfysik, Copenhagen (Denmark)). Phys. Lett., B; 58: No. 2, 142-144(1 Sep 1975).

Recently, it was shown that a qualitative description of the spectroscopic properties of odd-odd deformed nuclei can be obtained by using polarized single-particle spin operators in the effective neutron-proton interaction. It is shown that for a more quantitative description of the Gallagher-Moszkowski doublets one must also include a long-range repulsive term. Both effects are expected to be due to the core polarization. (NL)

**13730** KNOCK-ON REACTION TO UNBOUND STATES. Kozlowski, M. (Warsaw Univ. (Poland). Instytut Fizyki Doswiadczalnej). Phys. Lett., B; 58: No. 2, 145-146(1 Sep 1975).

The possibility of the observation of IAR states in $(p,\alpha\beta)$ low energy (30 MeV) reaction is discussed. A simple model for the knock-on mechanism for these reactions is proposed. As an example the investigation of $^{170}Yb(p,\alpha\beta)^{166}Er$ is proposed. (NL)

**13731** CORRECTIONS TO GLAUBER THEORY IN THE OPTICAL LIMIT. Harrington, D. R. (Rutgers-the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Phys. Lett., B; 58: No. 1, 5-8(18 Aug 1975).

In the optical limit the leading finite energy correction to Glauber theory for scattering from a composite system in the fixed scatterer approximation takes a form similar, but not identical, to the leading correction to scattering from an elementary system via the optical potential. (NL)

**13732** NEW METHOD FOR CALCULATING ROTATIONAL SPECTRA FOR COMPLEX NUCLEI. Wong, S.K.M.; Ng, W. Y.; Trainor, L.E.H. (Toronto Univ., Ontario (Canada). Dept. of Physics). Phys. Lett., B; 58: No. 1, 9-12(18 Aug 1975).

A new method has been devised for calculating the rotational spectra of complex nuclei which is much simpler than methods using projection techniques but which gives results comparable to them. The method is a modified version of the constrained Hartree-Fock-Skyrme technique. (NL)

**13733** THEORY OF QUANTIZED FRICTION. Skagerstam, B. K. (Bedford Coll., London (UK). Dept. of Mathematics). Phys. Lett., B; 58: No. 1, 21-25(18 Aug 1975).

Some of the most elementary aspects of a theory of quantized friction are discussed which could be relevant in the context of nuclear viscosity. Solutions of the relevant Schroedinger-Langevin equation are discussed and it is shown that these have the remarkable property of being stationary for large times i.e., asymptotically stationary. This concept is also used in a discussion of general structure of the solutions. (NL)

**13734** THEORETICAL APPROACH TO THE PROBLEM OF PARTIAL EQUILIBRIUM IN HEAVY ION REACTIONS. Moretto, L. G.; Sventek, J. S. (California Univ., Berkeley (USA). Dept. of Chemistry). Phys. Lett., B; 58: No. 1, 26-30(18 Aug 1975).

The cross sections and the angular distributions of fragments emitted in heavy ion reactions are calculated on the basis of a diffusion mechanism associated with the mass (charge) asymmetry of a short-lived intermediate complex. The calculated quantities are compared with experimental results. (NL)

**13735** SELF-CONSISTENT CALCULATIONS OF GROUND STATE PROPERTIES FOR UNSTABLE NUCLEI. Beiner, M.; Lombard, R. J. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire); Mas, D. (Orleans Univ., 45 (France). Lab. de Physique). Nucl. Phys., A; 249: No. 1, 1-28(8 Sep 1975).

The energy density formalism has been applied to calculations of bulk properties of light stable and unstable nuclei with $1 \leq Z \leq 8$ and to Na, K and Rb isotopes. The results emphasize many interesting features arising from the self-consistency. The most striking effect is the appearance of N = 16, 34 and 58 as neutron magic numbers for unstable nuclei, together with a weakening of the shell closure at N = 20 and 28. In spite of its intrinsic limitations, the general accuracy is sufficient for the model to be of practical use. For instance the predictions concerning the drip lines are in good agreement with the experimental situation. Finally, the influence of the neutron excess on the interaction barrier is briefly discussed. (NL)

**13736** OPTICAL MODEL ANALYSIS OF QUASIELASTIC (p, n) REACTIONS AT 22.8 MeV. Carlson, J. D.; Zafiratos, C. D.; Lind, D. A. (Colorado Univ., Boulder (USA). Nuclear Physics Lab.). Nucl. Phys., A; 249: No. 1, 29-62(8 Sep 1975).

Quasielastic (p,n) differential cross sections have been measured for 29 nuclei ranging from $^{9}$Be to $^{208}$Pb at an energy of 22.8 MeV in approximately 7.5° steps from 10° to 152°. The results have been analyzed with a distorted-wave Born approximation in terms of the generalized optical model due to Lane. Starting with a complex isospin interaction form factor, $U_1$, deduced from the Becchetti-Greenlees global set of proton optical parameters, the shape of the surface-peaked, imaginary part of $U_1$ was varied until good fits to the data were obtained. The shape of the real part of $U_1$ and the ratio of the real to imaginary well depths were kept fixed at the Becchetti-Greenlees values. The resulting best-fit form factors had overall strengths 20-30% less than the Becchetti-Greenlees value. Further, the resulting imaginary part of $U_1$ was found to peak at a decreasing radius relative to the real part of $U_1$ with an increasing width as A increased. A smoothed parametrization of the best-fit $U_1$ is given for all nuclei with A > 40. The individual best-fit $U_1$ is used to generate self-consistent neutron optical potentials from the Becchetti-Greenlees proton optical potentials as prescribed by the Lane model. Neutron elastic scattering angular distributions and reaction cross sections predicted by these self-consistent potentials are in good agreement with observed neutron scattering data. (NL)

**13737** TAYLOR EXPANSIONS IN HARTREE-FOCK AND ISOSCALAR NUCLEAR SHIFTS. Zamick, L. (Rutgers-the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Nucl. Phys., A; 249: No. 1, 63-75(8 Sep 1975).

Changes in the bulk properties of a nucleus when a particle is added to an even system are considered. The main thing shown is that one can determine these changes by doing a Hartree-Fock calculation on the even system only. One must, however, also examine what happens away from equilibrium, or at least get derivates at equilibrium in the even system. Expressions are obtained for E0 isoscalar effective charges which involve, but do not determine, the nuclear compressibility, likewise expressions for E2 effective charges which involve but do not determine the quadrupolarizability. Illustrative examples using simple interactions are presented. E0 effective charge corrections in a major shell are larger by roughly a factor of two in orbits with high radial quantum number and E2 effective charge corrections are near unity. Finally, simultaneous changes in the radial and quadrupole shapes are considered. (NL)

**13738** TIME-DEPENDENT HARTREE-FOCK THEORY WITH SKYRME'S INTERACTION. Engel, Y. M.; Brink, D. M.; Goeke, K. (Oxford Univ. (UK). Dept. of Theoretical Physics); Krieger, S. J. (Oxford Univ. (UK). Nuclear Physics Lab.); Vautherin, D. (Paris-11 Univ., 91-Orsay (France). Inst. de Physique Nucleaire). Nucl. Phys., A; 249: No. 2, 215-238(15 Sep 1975).

The time-dependent Hartree-Fock theory (TDHF) and its abiabatic approximation (ATDHF) are formulated in coordinate space using effective density-dependent interactions of Skyrme type. For this purpose it is necessary to derive the energy density of a Slater determinant without assuming the single-particle states to be invariant under time-reversal. The corresponding Hartree-Fock Hamiltonian is obtained by varying the total energy with respect to the single-particle density matrix. With the Skyrme interaction TDHF theory leads to an equation of continuity for the single-particle density. The ATDHF equation is transformed into a finite set of inhomogeneous differential equations. Hydrodynamic-like expressions for the collective kinetic energy are established in case the single-particle wave functions have certain generalized scaling properties. TDHF and ATDHF are applied to the description of isoscalar monopole vibrations in $^{16}$O and $^{40}$Ca. (NL)

**13739** COLLECTIVE MODELS OF GIANT STATES WITH DENSITY-DEPENDENT INTERACTIONS. Golin, M.; Zamick, L. (Rutgers-the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Nucl. Phys., A; 249: No. 2, 320-328(15 Sep 1975).

Using a simple density-dependent interaction $-\alpha\delta(r_1-r_2) + \gamma\rho^0(\frac{1}{2}(r_1+r_2))\,\delta(r_1-r_2)$, with the parameters $\alpha$ and $\gamma$ adjusted to give the correct binding energy and the correct radius, it is shown that the energy of the giant quadrupole state is $(\hbar/2\pi)\omega\sqrt{2}$. This is the same result obtained by Mottelson, Hamamoto and Suzuki, using, however, different methods. Finite range terms are then considered in the interaction, such as those considered by Vautherin and Brink, and a fairly simple modification of the above result. In contrast to the above quadrupole result the energy of the giant monopole states is not unique but depends linearly on sigma, the power of the density. The Inglis cranking model is used to get the relevant mass parameters. This model appears to work very well for high frequency vibrations. (NL)

**13740** PIONS INTERACT WITH NUCLEI. Huefner, J. (Heidelberg Univ. (F.R. Germany). Inst. fuer Theoretische Physik). Phys. Rep.; 21: No. 1, 1-79(Sep 1975).

This is a pedagogically oriented report about the interaction of pions with nuclei. The review is restricted to low and medium energy phenomena i.e., to pion energies below 300 MeV. Pionic atoms, pion absorption and production, and the scattering around the (3,3) resonance are the main topics. The experimental data are interpreted within the frame of multiple scattering theory. The basic ideas are critically analyzed and open problems are stressed. (NL)

**13741** DELBRUECK SCATTERING. Papatzacos, P.; Mork, K. (Trondheim Univ. (Norway). Institutt for Fysikk). Phys. Rep.; 21: No. 2, 81-118(Sep 1975).

The various calculations of the Delbruck scattering amplitude are presented. This is followed by some generalities on the elastic scattering of photons by heavy atoms and finally by a review of the experiments together with a comparison with the calculations. (NL)

**13742** CHARGE EXCHANGE: THEORY AND APPLICATION TO PROTON-CARBON COLLISIONS. Wei, C. C. (Department and Institute of Physics, National Tsing Hua University, Hsinchu, Taiwan). Physica; 80: No. 5-6, 601-612(Nov 1975).

Cross sections for electron capture by protons hitting a many-electron target are calculated in Born approximation for the 1s, 2s,2p,3s,3p,4s,4p,4d,4f hydrogen states. The T matrix is expressed in terms of the Coulomb integral. The Coulomb integral which appears frequently in ion-atom collisions is expressed in an algebraic form by a computer oriented technique. It enables us to express the T matrix exactly and analytically and to evaluate the nuclear contribution to the capture cross section easily. The expression is applied to calculate the electron-capture cross sections on carbon for protons. For physically interesting parameters, the differential cross sections are plotted for capture in the 1s,2s,2p hydrogen states versus incident energy at a given scattering angle of 1°. (NL)

**13743** NUCLEAR HYDRODYNAMICS. Bertsch, G. F. (Los Alamos Scientific Lab., N. Mex. (USA)). Nucl. Phys., A; 249: No. 2, 253-268(15 Sep 1975).

Continuum equations are derived for nuclear motion in the framework of time-dependent Hartree-Fock theory. The equations describe an elastic medium at low frequencies and independent particle motion at high frequencies. The giant quadrupole and monopole states are derived from the theory. The quadrupole

energy in the Fermi gas model is given by E equals [(h/2 pi)$^2$/m] [6k/sub F/$^2$/5 ($r^2$)]/sup 1/2. The monopole energy depends on the details of the underlying Hartree-Fock theory. For higher multipoles, the theory only gives a mean energy of the strength function. The Wigner density matrix of the theory is derived. From this it is argued that all modes except the giant quadrupole and monopole are subject to Landau damping. (NL)

**13744** SYSTEMATICS OF THE POPULATION OF ROTATIONAL BANDS IN DEFORMED NUCLEI IN THE (n,gamma) REACTION. MacPhail, M. R.; Casten, R. F.; Kane, W. R. (Brookhaven National Lab., Upton, N. Y. (USA)). Phys. Lett., B; 58: No. 1, 39-42(18 Aug 1975).

In the (n,gamma) reaction, a striking regularity occurs in the populations of low-lying states belonging to the same rotational band: as a function of excitation energy the populations for successive spins lie on smooth curves which, for different bands, are essentially parallel. This systematic behavior offers a new tool for classifying states in deformed nuclei. (NL)

**13745** COLLECTIVE MODEL DESCRIPTION OF TRANSITIONAL ODD-A NUCLEI. I. The Triaxial-Rotor-Plus-Particle Model. Meyer-ter-Vehn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 249: No. 1, 111-140(8 Sep 1975).

The energy spectrum of an odd nucleon coupled to a triaxial rotating core has been calculated as a function of the deformation beta, the asymmetry gamma and the Fermi energy lambda /sub F/. Results are presented in a series of plots with the odd nucleon restricted to a single j-shell and the parameters covering the area which is of most interest for transitional odd-A nuclei in the A equals 135 and the A equals 190 mass regions. The results apply to unique-parity spectra which are based either on particle or hole states in a j equals 11/2 shell, but hold also for j equals 3/2 and j equals 13/2. In addition, results on moments and transition probabilities are given. The quasiparticle-rotor Hamiltonian is derived with special emphasis on the particle-hole symmetry. The analytic solution for the even triaxial rotor at gamma equals $30^0$ is given. Concerning the odd-A spectrum, characteristics which can be tested experimentally are discussed, and a qualitative physical interpretation is given. In particular, band structures in the triaxial region and their approximate classification are pointed out. (NL)

**13746** COLLECTIVE MODEL DESCRIPTION OF TRANSITIONAL ODD-A NUCLEI. II. Comparison with Unique Parity States of Nuclei in the A equals 135 and A equals 190 Mass Regions. Meyer-ter-Vehn, J. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Nucl. Phys., A; 249: No. 1, 141-165 (8 Sep 1975).

Recent experimental data on unique-parity spectra of odd-alpha nuclei in the A equals 135 and A equals 190 mass regions are compared in a systematic way with calculated energies and transition probabilities of a quasiparticle coupled to a rotating triaxial core. The comparison yields detailed evidence for triaxial shapes. Complex spectra of strongly coupled structure as well as decoupled structure and various intermediate types are reproduced by the model with core parameters beta and gamma determined from neighboring even nuclei. The coexistence of DELTA I equals 1 band structures, seen in some of the experimental spectra, is explained as a consequence of the shape asymmetry. In the A equals 190 region, the odd-A spectra confirm the existence of a gradual shape transition from prolate-type shapes ($^{186}$Os, gamma equals $16^0$) to oblate-type shapes ($^{188}$Hg, gamma equals $37^0$). Energies and lifetimes in A approximately 135 nuclei reveal prolate triaxial shapes with gamma-values in the range $20^0$ less than gamma less than $30^0$. Contrary to the expectation of very gamma-soft, fluctuating shapes which is based on calculated potentials, the present work seems to indicate that a number of transitional nuclei may have rather stable triaxial shapes. (NL)

**13747** K-ELECTRON EJECTION IN beta$^-$ DECAY: P/sub K/ or 1/2 P/sub K/. Freedman, M. S. (Argonne National Lab., Ill. (USA)). Nucl. Phys., A; 249: No. 1, 182-184(8 Sep 1975).

It is argued that a recent claim that there is an error of a factor of two in the Law-Campbell theory of K-electron shake-off in beta$^-$ decay is wrong. (NL)

**13748** EFFECTIVE INTERACTIONS AND OPERATORS IN NUCLEI. Volume I. Abstracts. Proceedings of International Topical Conference Held at Tucson, Arizona, June 2-6, 1975. Barrett, B. R. (ed.). New York; American Physical Society (1975). 44p. (CONF-750663-P1(Absts.)).

Abstracts of 36 contributed papers on effective interactions and operators are assembled. (SDF)

**13749** LARGE-ANGLE OSCILLATIONS IN HEAVY ION ELASTIC AND INELASTIC SCATTERING. Da Silveira, R. (Paris-11 Univ., 91 - Orsay (France). Inst. de Physique Nucleaire); Leclerq-Willain, C. (Brussels Univ. (Belgium)). J. Phys. (Paris), Lett.; 36: No. 5, L.117-L.119(May 1975).

The oscillatory behaviour observed at large angles in heavy ion elastic and inelastic scattering cross-sections at energies above the Coulomb barrier is interpreted as an interference effect between rainbow scattering and the contribution coming from the negative branch of the classical deflection function. (FR)

**13750** TRANSFER REACTIONS INDUCED BY HEAVY IONS. Mallet-Lemaire, M. C. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service de Physique Nucleaire a Basse Energie). J. Phys. (Paris), Colloq.; No. 5, 85-92(1974). (In French)

From symposium on nuclear physics applied to cyclotrons and tandems; Louvain-la-Neuve, Belgium (27 May 1974).

A review is given for the recent progress performed in the study of transfer reactions induced by heavy ions. In the section devoted to the reaction mechanism, the main features of these transfer processes are discussed. The one-nucleon transfer reactions show the dependence of the transfer cross-sections on the dynamic effects. Secondly, the presence of oscillations in the angular distributions is discussed in terms of a very simple diffractional model. It shows that the transfer can be a very sensitive probe of the nuclear potential. Finally, few examples dealing with two-nucleon transfer reactions on vibrational targets point out the contribution of two-step process. (FR)

**13751** DIRECT CAPTURE, CORRELATIONS, AND OTHER NON-STATISTICAL EFFECTS. Lane, A. M. (United Kingdom Atomic Energy Authority, Harwell, Eng.). pp 31-52 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A historical review of the subject is presented. The earliest phase (starting 1953) consisted in the accumulation of data indicating non-statistical effects i.e. those inconsistent with the extreme statistical view of the Hauser-Feshbach model. A subsequent phase (starting 1960) was concerned with finding alternative models that could be fitted to the data; the result was the discovery that a naive "valence" model works very well. The recent phase (starting 1969) consists of theoretical efforts to understand this success. (auth)

**13752** SHELL-MODEL APPROACH TO THE THEORY OF LOW-ENERGY NEUTRON CAPTURE. Cugnon, J.; Mahaux, C. (Univ., Liege). pp 81-97 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Some applications of the shell-model approach to the giant resonances are reviewed and then the region of isolated resonances is discussed with main emphasis on deviations from the statistical model due to channel capture. Various parametrizations are written down for the scattering matrix, and the identification of the corresponding resonance and background parameters with theoretical quantities is discussed. The relationship between the present formulation and the work of Lane, Lynn and Mughabghab is exhibited, both formally and numerically. (4 figures, 1 table) (auth)

**13753** SIMPLE CONFIGURATION IN THE CAPTURE STATE AND THE GENERAL PICTURE OF NUCLEAR STATE COMPLICATIONS. Soloviev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 99-117 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

It is asserted that the effective nuclear forces and the methods of solving the many-body problem may serve as a basis for describing states of low, intermediate and high excitation energy. It is indicated that it is important to study nuclear structure complications with increasing excitation energy and fragmentation of single-particle and many-particle states. The foundation of the model for describing fragmentation which is based on the account of the quasiparticle-phonon interaction are presented. The results of calculations of fragmentation for the $(631)\downarrow$, $(620)\uparrow$, $(640)\uparrow$ and $(600)\uparrow$ one-quasiparticle states in $^{239}$U are given. It is shown that the state strength is distributed over a wide energy interval, the distribution maximum is shifted down with respect to the single-particle energy. The degree of fragmentation is shown to depend strongly on the position of the

single-particle level with respect to the Fermi level. A modified version of the model is given for treating highly excited states of the type of giant resonances and for studying their influence on the structure of states of intermediate excitation energy. The general assumptions of the approach based on the operator form of the wave function of highly excited states are presented, and the contribution of individual simple configurations to the neutron resonance wave functions is estimated. It is shown in which case the valence neutron model can be employed. The compound-state structure is discussed. (2 figures, 3 tables) (auth)

**13754** PHOTON STRENGTH FUNCTIONS. Bartholomew, G. A.; Khanna, F. C. (Atomic Energy of Canada Ltd., Chalk River). pp 119-144 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Methods for extracting gamma-ray strength functions are discussed critically. The behavior of the E1 strength function below 10 MeV in heavy elements is outlined and various theoretical explanations are reviewed. The present status of understanding of M1 and higher multipoles is discussed briefly. Some problems of interest to both experimentalists and theorists are outlined. (15 figures) (auth)

**13755** TIME CHARACTERISTICS OF POTENTIAL SCATTERING AND CAPTURE OF SLOW S-NEUTRONS. Khilmanovich, A. M.; Rudak, E. A. (Inst. of Physics, Minsk). pp 158-159 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A residence time of s-neutrons in the target nucleus region with potential scattering is estimated. (auth)

**13756** ROLE OF THE ENTRANCE AND EXIT DOORWAYS FOR LOW ENERGY NUCLEONS. Brozosko, J. S. (Univ., Warsaw). pp 171-174 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The relation between semi-direct and compound nucleus processes proceeding via the same intermediate configuration is studied. Qualitative analysis demonstrates that for low energy projectiles the main part of the process is connected with compound nucleus decay. (auth)

**13757** ROTATION EFFECT ON THE NUCLEAR LEVEL DENSITY. Malov, L. A.; Soloviev, V. G.; Voronov, V. V. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 175-178 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

The effect of the rotational motion on the density of the highly excited states of deformed nuclei is studied. It is shown that the account of the rotational motion makes the description of the high-spin density essentially better. The spin dependence of the density is found to be close to the one obtained by the statistical model. It is shown that a semi-microscopic approach accounting for the vibrational and rotational motions gives a good description of the excited state density for deformed nuclei at the neutron binding energy. (auth)

**13758** GAMMA RADIATION WIDTHS FROM THE RENORMALIZED GAS MODEL AT THERMAL NEUTRON ENERGIES. Chatterjee, A. (Univ., Calcutta); Ghosh, S. K.; Mukherjee, S. pp 186-190 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

It has been possible to approximately evaluate the integral appearing in the total gamma radiation width gamma$_\gamma$. The statistical level density at a given excitation energy has been assumed to be of the standard form. The single particle level density parameter of our renormalized Fermi gas model, $a_{RGM}$, has been used in the computations. The nuclear structure effects in gamma$_\gamma$ are qualitatively reproduced, but large normalization factors are needed for numerical fits. The analysis emphasizes the need of reformulation and reanalysis of the dipole gamma emission process. (auth)

**13759** FAST NEUTRON CAPTURE. Bergqvist, I. (Univ. of Lund, Sweden). pp 199-216 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A review of recent developments in theory and experiment of fast neutron capture is presented. In the neutron energy range of 5-15 MeV the experimental data can be described rather well by the direct-semidirect capture theory, in particular with a recently proposed formulation of this theory involving a complex form of the coupling interaction between the incident neutron and the target nucleus. New measurements of the capture cross-section at 14–15 MeV using the activation technique definitely prove that old activation results are in error. Little new information is available about capture processes in the neutron energy range between about 100 keV and 5 MeV; more experimental results are requested in this range. (auth)

**13760** EFFECTIVE INTERACTIONS AND OPERATORS IN NUCLEI. Volume II. Proceedings of the Tucson International Topical Conference on Nuclear Physics, Tucson, Arizona, June 2–6, 1975. Barrett, B. R. (ed.). Lecture Notes in Physics, Volume 40. New York; Springer-Verlag (1975). 350p. (CONF-750663-P2).

Separate abstracts are prepared for 13 papers appearing in NSA, three of which also appear in ERDA Energy Research Abstracts. (SDF)

*For abstracts of individual papers see: 13516, and 13761–13772.*

**13761** TIME-DEPENDENT, DIAGRAMMATIC ANALYSIS OF EFFECTIVE INTERACTIONS AND OPERATORS. Ratcliff, K. F. (State Univ. of New York, Albany). pp 42-63 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

Degenerate perturbation theory is used as a natural extension of the linked-cluster expansion of non-degenerate perturbation theory to discuss the analysis of diagrams. Factorization of the first and second kinds are illustrated and applied to folded diagram expansions. These methods are then used to study effective operators. (15 figures) (SDF)

**13762** DETERMINATION OF EFFECTIVE MATRIX ELEMENTS FROM EXPERIMENTAL DATA. Talmi, I. (Weizmann Inst. of Science, Rehovoth, Israel). pp 64-79 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

Shell model calculations of matrix elements for effective interactions in nuclei are considered. Different forms for the effective interaction are examined and examples are given relating experiment to theory. (14 figures, 1 table) (SDF)

**13763** HOW DO WE DECIDE WHICH UNPERTURBED BASIS TO USE. What Is the Role of Self-Consistency. Sauer, P. U. (Technical Univ., Hanover). pp 80-95 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

The choice of a single-particle Hamiltonian, $H_0$, for the calculation of shell structure in nuclei is discussed. Presently, a micro, a semi-micro, and a phenomenological choice of $H_0$ are available, each of which is an improvement over the standard oscillator Hamiltonian of low order shell model calculations. It is shown that a self-consistent choice of $H_0$ effectively reduces diagrams with self-energy insertions, and the effect of this on standard shell model results is briefly examined. (8 figures) (SDF)

**13764** PERTURBATION CALCULATION IN A DOUBLE-PARTITIONED HILBERT SPACE. Barrett, B. R. (Univ. of Arizona, Tucson). pp 119-133 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

A method for determining the effective interaction for any number of valence nucleons outside a closed-shell core is discussed. This approach, the method of successive partitioning,

allows the most accurate possible computation in low order perturbation theory. Only double partitioning is considered in detail, and calculations are presented for mass 18 nuclei. (1 table, 8 figures) (SDF)

**13765** AVERAGE EFFECTIVE INTERACTION. Goode, P. (Rutgers–the State Univ., New Brunswick, NJ). pp 134-151 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

The determination of the effective interaction between two nucleons inside a nucleus from their interaction in free space is a critical test for any shell theory of nuclear structure. A theoretical method is described and the average shell model effective interaction is calculated through fourth order in G, the Brueckner effective interaction. It is found that the fourth order averages are as large as second or third order due almost entirely to a failure of the number conserving sets to self-cancel. This is attributed to a nuclear size effect. It is suggested that the convergence properties of the series for the shell model effective interaction might be improved by elimination of the folded diagrams, and a partial summation of the number conserving sets might be considered as an appropriate rearrangement of the series. (4 tables, 10 figures) (SDF)

**13766** ALGEBRAIC STRUCTURE OF EFFECTIVE INTERACTIONS AND OPERATORS. Convergence Properties of the Perturbation Expansions. Weidenmueller, H. A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). pp 152-167 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

Algebraic expressions for effective interactions and operators are used to show that the calculation of both eigenvalues and transition matrix elements is possible without additional normalization problems only if these operators are Hermitian. Infinitely many such Hermitian representations exist, and some special choices are pointed out. Independently of the representation chosen, the convergence of the perturbation expansions hinges on the positions of branch points connected with intruder states. Practical aspects of this problem and the rate of convergence of the series in the absence of close-lying branch points are discussed. (auth)

**13767** RELEVANT ASPECTS OF STATISTICAL SPECTROSCOPY. French, J. B. (Univ. of Rochester, NY). pp 191-206 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

Three aspects of statistical spectroscopy are studied: (1) information obtainable from complex spectra, (2) procedures for spectroscopy in huge model spaces, and (3) ways of identifying and calculating measurable parameters of the effective Hamiltonian and other operators, and of comparing different Hamiltonians. (4 figures) (SDF)

**13768** INFINITE PARTIAL SUMMATIONS. Sprung, D. W. L. (McMaster Univ., Hamilton, Ont.). pp 207-227 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

A brief review is given of those aspects of the effective interaction problem that can be grouped under the heading of infinite partial summations of the perturbation series. After a brief mention of the classic examples of infinite summations, the effective interaction problem for two extra core particles is examined. Their direct interaction is summed to produce the G matrix, while their indirect interaction through the core is summed in a variety of ways under the heading of core polarization. The work of Weidenmueller and co-workers is mentioned, specifically the use of Pade approximants as a method of summing the series. Finally, the shell model diagonalization method of Rowe et al. is discussed. Only a brief outline is given of the analogous work on the effective charge problem. (auth)

**13769** PADE APPROXIMANTS AND THE CALCULATION OF EFFECTIVE INTERACTIONS. Schucan, T. H. (Swiss Inst. for Nuclear Research, Villigen). pp 228-249 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

It is known that the series expansion of the effective interaction in nuclei diverges in practical applications due to the occurrence of low lying collective states. An approximation scheme which can be used to overcome the difficulties connected with this divergence is reviewed and it is shown that a continued fraction expansion can be used to calculate the eigenstate that has the larger overlap with the model space. An extension of this method is obtained by using Pade approximants (P.A.) which are then applied to the effective interaction, and to related matrices and matrix elements. Mathematical properties of the P.A. are discussed in light of these applications. (7 figures) (SDF)

**13770** DENSITY DEPENDENT INTERACTIONS. Negele, J. W. (Massachusetts Inst. of Tech., Cambridge). pp 270-295 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

Density dependent interactions have been treated on two different levels. The most fundamental level deals with G(W) and involves a systematic expansion of the density matrix about the center of mass of the two interacting particles. It has been shown that only the local behavior of the density matrix is essential. Thus a systematic expansion for G(W) is obtained such that the first term depends only on the local density and the next term involves the local kinetic energy density. These ideas generalize straightforwardly to approximating the three-body Faddeev equations in finite nuclei, and offer the most computationally practical scheme for use in heavy nuclei. The second level of approximation is to obtain an approximate Hamiltonian density which offers the computational simplicity of Skyrme-like forces. Although such a reduction offers tremendous technical simplification in calculations, it suffers from a serious lack of generality. Thus, it is not in fact valid for many of the applications for which the Skyrme force is presently being used and serious effort should be devoted to generalizing it for each of these applications. (7 figures) (auth)

**13771** CALCULATION OF OTHER EFFECTIVE OPERATORS. Ellis, P. J. (Univ. of Minnesota, Minneapolis). pp 296-312 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

A great deal has been written about the calculation of effective interactions for use in shell model calculations. Beginning with a basic perturbation theory framework, a brief review is presented of the calculation of other effective operators, focusing primarily on effective quadrupole operators required for calculating E2 transitions and moments. Results of order-by-order calculations and partial summations are given. (9 figures) (SDF)

**13772** THEORY VERSUS THEORY AS A TEST OF THE EFFECTIVE INTERACTION. Zamick, L. (Rutgers—the State Univ., New Brunswick, NJ). pp 313-329 of Effective Interactions and Operators in Nuclei. Volume II. Barrett, B. R. (ed.). New York; Springer-Verlag (1975).

From international topical conference on effective interactions and operators in nuclei; Tucson, Arizona, USA (2 Jun 1975). See CONF-750663-P2.

Using density dependent interactions of the Skyrme type, the energies of the giant isoscalar monopole and quadrupole states in T.D.A. and R.P.A. are calculated. Then a collective model involving the Inglis cranking formula is used. Very close agreement is obtained. The simplicity of using oscillator wave functions with Skyrme forces, especially for constructing the equation of state, is noted. The isoscalar effective charges are calculated in the R.P.A. and compared with the Hartree Fock calculations. There are significant differences, and attempts to make the results converge, by making the deformation parameters for the valence nucleon different from those of the core, are discussed. Most of the calculations were done by Michaela Golin. (3 tables) (auth)

**13773** INVESTIGATION OF NUCLEAR STRUCTURE BY SCATTERING PROCESSES AT HIGH ENERGIES. Proceedings of the International School of Nuclear Physics, Erice, Sicily, Italy, 22 September-1 October 1974. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975). 364p. (CONF-7409109-). $33.25.

From international school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974).

Abstracts for eight papers have been prepared for appearance in NSA, one of which also appears in ERDA Energy Research Abstracts (ERA). (SDF)

*For abstracts of individual papers see: 13236, 13391, 13442, and 13774–13778.*

**13774** CURRENT PROBLEMS OF NUCLEAR STRUCTURE. Wilkinson, D. (Oxford Univ.). pp 1-119 of Investigation of Nuclear Structure by Scattering Processes at High Energies. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From international school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974). See CONF-7409109.

Topics of current interest in nuclear structure research are discussed and include (1) the isotensor term in the electromagnetic interaction, (2) charge symmetries in the strong interactions, (3) charge distribution of the nucleus, (4) neutron distribution in the nucleus, (5) parity violation in nuclear wave functions, (6) super-allowed Fermi $\beta$ decay and nucleon structure, and (7) second class weak currents. (5 figures, 2 tables, 233 references) (SDF)

**13775** PION–NUCLEUS INTERACTIONS. Ericson, T. (CERN, Geneva). pp 165-203 of Investigation of Nuclear Structure by Scattering Processes at High Energies. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From international school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974). See CONF-7409109.

The significant properties of $\pi$-nucleus interactions at low and intermediate energies ( < 500 MeV) are dealt with. It is in this energy range that the pionic effects distinguish themselves from other hadronic processes. (SDF)

**13776** PROTON–NUCLEUS SCATTERING AT INTERMEDIATE ENERGY. Lambert, E. (Univ., Neuchatel, Switzerland). pp 245-261 of Investigation of Nuclear Structure by Scattering Processes at High Energies. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From international school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974). See CONF-7409109.

A brief review is given of some aspects of the multiple scattering process using a formalism which focuses, for elastic scattering, on the optical potential. The first two orders of this optical potential are studied and are seen to be essentially an expansion in terms of nuclear correlation functions of increasing orders. Some attention is paid to the nucleon pair correlation function which, besides the target form factor and the elementary nucleon-nucleon interaction, is needed to solve the scattering problem. Finally, a coupled channel approach to the effects of the pair correlation is discussed for the case of p-$^4$He scattering. The present disagreement with experiment is commented on. (4 tables, 59 references, 30 figures). (SDF)

**13777** RECENT DEVELOPMENTS IN ELECTRON SCATTERING. Mougey, J. (CEN de Saclay, Gif-sur-Yvette, France). pp 263-310 of Investigation of Nuclear Structure by Scattering Processes at High Energies. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From international school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974). See CONF-7409109.

Recent experimental developments in electron scattering are reviewed with emphasis on three main topics: (1) the analysis of elastic electron scattering to get charge distributions in a model independent way, (2) the study of giant resonances with electron scattering, and (3) the (e,e'p) reactions. (4 tables, 30 figures, 59 references) (SDF)

**13778** ELECTRON- AND PHOTON-NUCLEUS INTERACTION AT VERY HIGH ENERGIES. Roessle, E. (Univ., Freiburg, i. B.). pp 311-360 of Investigation of Nuclear Structure by Scattering Processes at High Energies. Schopper, H. (ed.). Amsterdam; North-Holland Publishing Co. (1975).

From international school of nuclear physics, the investigation of nuclear structure by scattering processes at high energies; Erice, Italy (22 Sep 1974). See CONF-7409109.

The following topics in high energy electron- and photon-nucleus interactions are discussed: vector meson dominance in the electromagnetic interaction, elementary processes on nucleons, processes occurring when nuclei are bombarded by high energy electrons, including photoproduction of pions and $\rho$ mesons, isobaric configurations in nuclei, and sum rules. (81 references, 37 figures) (SDF)

# PHYSICS (RADIATION AND SHIELDING)

## Radiation Physics

*Refer also to abstracts 12900, 12901, 12918–12920, 12929, 12951, 12952, 12958, and 13058.*

**13779** (AECL-4914) COMPILATION OF REALISTIC STOPPING POWERS FOR $^4$He IONS IN SELECTED MATERIALS. Ward, D.; Forster, J. S.; Andrews, H. R.; Mitchell, I. V.; Ball, G. C.; Davies, W. G.; Costa, G. J. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1975. 12p. Dep. NTIS (US Sales Only) $4.50. AECL $0.50.

Stopping powers are given for $^4$He ions in the energy range 400 keV to 20 MeV for some 21 materials, from beryllium to lead. In all cases, the numbers are based directly on experimental determinations. (auth)

**13780** (CONF-741040-P1, pp 97-119) USE OF A 3-MV PROTON ACCELERATOR FOR STUDY OF NOBLE GASES, INCLUDING LASER IONIZATION OF EXCITED STATES. Hurst, G. S.; Judish, J. P.; Nayfeh, M. H.; Parks, J. E.; Payne, M. G.; Wagner, E. B. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

The use of a pulsed 3-MV accelerator to study energy pathways in the noble gases is described. The objectives of pathways research are to obtain (1) information on the spectrum of excited states produced by a charged particle in a noble gas, (2) the rate of decay of the various states through various channels as a function of gas pressure, and (3) the modification of the decay channels due to the introduction of foreign species. A new energy pathways model is presented for helium as a general illustration. A method for the study of excited states, using a laser ionization technique is reported. Use is made of a laser which is tuned to a resonance transition between the desired excited state and some higher excited state. Photons in the same pulse photoionize the higher excited state; thus the ionization current vs photon wavelength has a resonance structure. Absolute yields of selected excited states can be obtained whenever the photon fluence per pulse is large enough to saturate the ionization current. A general summary is given of experimental facilities which include a 3-MV Van de Graaff accelerator, electronics for measuring radiation lifetimes, vacuum ultraviolet spectrometers, and a pulsed laser facility for direct study of excited states. Finally, the relevance of pathways research to (1) the interaction of radiation with matter, (2) the development of gas lasers, and (3) methods of ultrasensitive elemental analysis is pointed out. (auth)

**13781** (CONF-741040-P1, pp 336-346) ANGULAR BEHAVIOR OF STOPPING POWERS IN CARBON FOR HEAVY IONS BELOW 250 keV. Beauchemin, G.; Drouin, R. (Univ. Laval, Quebec). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Heavy ions, accelerated at energies below 250 keV are used to study the stopping powers (dE/dx) of thin carbon foils and their angular behavior. Energy losses are measured with a high-resolution magnetic spectrometer. Our results are compared with other experiments and with the Lindhard–Scharff–Schiott (LSS) theory. Discrepancies with the LSS theory increase at low energies for a given ion, and with increasing $Z_1$ at a given energy. For angular studies of the stopping power we obtain a characteristic curve dE/dx(theta), and find that its behavior can be related to the thickness of the foil (4 to 14 mu g/cm$^2$) and to the incident energy (40 to 240 keV) for Ar ions. (auth)

**13782** (CONF-741040-P1, pp 410-418) STATES OF ENERGETIC IONS IN SOLIDS. Datz, S. (Oak Ridge National Lab., TN). 1974.

From 3rd conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I. The Use of Small Accelerators in Research and Teaching. (North Texas State Univ., Denton (USA)).

Some new information relating to the atomic states and interactions of ions as they penetrate solids is presented. The demonstrated dependence of x-ray production cross sections upon ionic charge state is utilized by an ORNL-UT group as a measure of the charge on the ion penetrating a solid. In other work by an ORNL group it is shown that high velocity O ions (28 to 40 MeV) undergo very little charge exchange while passing through channels in Ag. Measurement of the stopping power for these particles is used to assess the effects of screening.

**13783** (FRNC-TH-561) MONTE CARLO SIMULATION OF THE EFFECT OF COMPENSATOR CONES ON THE ENERGY AND SPATIAL SPECTRA OF A 25-MeV PHOTON BEAM. Jitao, S. (Toulouse-3 Univ., 31 (France)). 1975. 84p. (In French). Dep. NTIS (US Sales Only) $6.00.

Thesis.

Calculation methods used for high energy particles (1 keV to 100 MeV) are given, and 25 MeV electron transport in a three laminar system is simulated. The photons produced by the electrons in this system are filtered by a variable thickness of lead, and several results are given, particularly the energetic and angular spectra of photons crossing the filter. The attenuation law of these photons in some semi-infinite systems is also given. (GHT)

**13784** (RD/B/N-3325) USERS MANUAL FOR THE ELECTRON TRANSPORT CODE ETRAN. Johnson, D. M. (Central Electricity Generating Board, Berkeley (UK). Berkeley Nuclear Labs.). Apr 1975. 17p. Dep. NTIS (US Sales Only) $4.50.

The Fortran IV electron transport code ETRAN has been mounted on the IBM System 370. This one-dimensional Monte-Carlo program can handle primary sources of electrons or photons and all interaction mechanisms are followed extremely accurately. The limited geometry options mean the code does not have wide application, but is designed primarily for investigation of specific interactions or as a standard for the development of more general codes. A users guide is given together with probable values of fundamental program parameters necessary in the applications likely to be encountered. Indications are given as to how efficiency can be improved for a particular problem, as running times tend to be long. (auth)

**13785** (SLAC-Trans-170) MECHANISM OF ENHANCEMENT OF CONTROLLABLE SECONDARY-ELECTRON EMISSION FROM FAST SINGLE ELECTRONS. Lorikyan, M. P.; Kavalov, R. L.; Trofimchuk, N. N.; Arvanov, A. N.; Gavalyan, V. G. (Erevanskij Fizicheskij Inst. (USSR)). Nov 1975. Translation of EFI-131(75). 30p. Dep. NTIS $4.00.

For porous KCl films (density approximately 2 percent, thickness 50-400 mu m), the controllable secondary electron emission (CSEE) from fast single electrons with energies of 0.7-2 MeV was studied. An electric field E of approximately $10^4$-$10^5$ V/cm was set up inside the porous films and the emission curves anti sigma equals f(E) and the energy spectra of the secondary electrons were measured. The mean emission coefficient anti sigma increases with increasing E, reaching a value of anti sigma approximately equal to 230. Internal enhancement of CSEE under the action of the E field is explained by a process similar to the Townsend semi-self-maintained discharge in gases. The mean free path L/sub e/ of the secondary electrons estimated on the basis of this mechanism of CSEE enhancement is in good agreement with the L/sub e/ value obtained independently from the energy spectra of the secondary electrons. The report examines the effect of the first critical potential U/sub il/ and of the electron affinity of the dielectric alpha on the formation of CSEE from a porous dielectric film. The possibility of using such films in particle detectors is discussed. (auth)

**13786** AVERAGE ENERGY EXPENDED PER ION PAIR IN LIQUID XENON. Takahashi, T. (Inst. of Physical and Chemical Research, Wako, Japan); Konno, S.; Hamada, T.; Miyajima, M.; Kubota, S.; Nakamoto, A.; Hitachi, A.; Shibamura, E.; Doke, T. Phys. Rev., A; 12: No. 5, 1771-1775(Nov 1975).

Measurements were made of the average energy W per ion pair formed in liquid xenon by internal-conversion electrons from $^{207}$Bi. Voltage pulses were observed resulting from electron collection either in liquid xenon or in a gaseous mixture of argon (95 percent) and methane (5 percent). The relative pulse heights for the two materials determine the ratio of the W values. Using the known W for the gaseous mixture, a liquid-xenon W of 15.6 +- 0.3 eV was obtained. This value is considerably smaller than the gas-phase values, 21.5 or 21.9 eV. For interpretation, Platzman's energy-balance equation was adapted to liquids, assuming a conduction-band picture. Theoretical values thus calculated agree well with experiment. (auth)

**13787** THEORETICAL STUDY OF THE ELECTRONIC STOPPING POWER OF IONS IN PLANAR CHANNELING. Haymann, P. (Rouen Univ., 76–Mont-Saint-Aignan (France)). pp

211-216 of Session d'etudes sur la canalisation des particules. Description et Applications. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975). (In French)

From meeting on particle channeling; Saclay, France (27 May 1974).

The results obtained by application of a recent theory to electronic slowing-down in a planar channel are presented. The agreement between the phenomenon and the results obtained in classical mechanics is discussed. (FR)

**13788** NEW SPECIAL NAMES OF SI UNITS IN THE FIELD OF IONIZING RADIATIONS. Wyckoff, H. O.; Allisy, A.; Liden, K. (University Hospital, Lund, Sweden). Radiology; 118: No. 1, 233-234(Jan 1976).

New SI units for ionizing radiations have been recommended by the International Commission on Radiation Units and Measurements (ICRU). These are the becquerel (symbol Bq), equal to the second to the power - 1, and the gray (symbol Gy), equal to the joule per kilogram. It was recommended that the roentgen be replaced as the unit of exposure by the coulomb per kilogram (C/kg), for which no new name was proposed. The ICRU recommends that the units rad, roentgen, and curie be gradually abandoned over a period of ten years and that preparatory steps to this end be taken as soon as possible by various national and international bodies in order to facilitate a smooth, safe, and efficient transition. (auth)

**13789** IONIZATION CHAMBER FOR THERAPY-LEVEL DOSIMETRY OF ELECTRON BEAMS. Morris, W. T.; Owen, B. (National Physical Lab., Teddington, Eng.). Phys. Med. Biol.; 20: No. 5, 718-727(Sep 1975).

This ionization chamber has been designed at the National Physical Laboratory in collaboration with the Hospital Physicists' Association. It is especially suitable for use with electron beams below 10 MeV. The sensitive volume is disc-shaped, 20 mm in diameter and 2 mm deep along the beam axis. Polarity effect is less than 0.1% at energies up to 6 MeV, allowing the chamber to be used with most existing dosimeter electrometers. The chamber is intended to be calibrated by the user against a secondary standard X-ray chamber using a Perspex phantom in $^{60}Co$ $\gamma$-radiation. Factors for converting "exposure" readings to absorbed dose in water are tabulated for beam energies up to 7 MeV. (auth)

**13790** INVESTIGATION OF THE STRAGGLING EFFECT ON CHARACTERISTIC X RAY EMISSION IN THICK TARGETS. Henoc, J. (Centre National d'Etudes des Telecommunications, Issy-les-Moulineaux, France); Maurice, F. J. Phys., D. (London); 8: No. 13, 1542-1550(11 Sep 1975).

The energy straggling effect has been studied by Bishop in a Monte Carlo calculation to investigate the mean energy losses of electrons in a thick target. The statistical energy losses of electrons are incorporated in a Monte Carlo calculation of the depth distribution of characteristic x-ray production. (auth)

**13791** STOPPING POWERS OF COPPER, SILVER, AND GOLD FOR PROTONS AND HELIUM IONS OF LOW ENERGY. Nomura, A.; Kiyono, S. (Tohoku Univ., Sendai). J. Phys., D (London); 8: No. 13, 1551-1559(11 Sep 1975).

Protons and helium ions in the energy range 4 to 16 keV have impinged on free films of copper, silver and gold of thicknesses from 300 to 700 Å. The stopping powers have been determined by measuring the energy spectra of the ions transmitted within a cone of 3° half-angle. As for the stopping power for helium ions, the nuclear stopping power is very small compared with the electronic stopping power in this method. The experimental results show that the dependence of the electronic stopping power on the ion velocity is almost in quantitative agreement with the Lindhard, Scharff and Schiott theory. (auth)

**13792** ENERGY LOSS OF TRANSMITTED AND BACKSCATTERED ELECTRONS. Fitting, H. J. (Rostock Univ., Ger.). J. Phys., D (London); 8: No. 13, 1480-1486(11 Sep 1975).

The energy distributions of electrons transmitted through thin free films of Be, Al and Ge with initial energies of $E_0$ = 0.5 to 4.0 keV have been investigated with a spherical retarding-field analyser. The most probable ($E_m/E_0$) and mean ($\bar{E}/E_0$) energies as a function of the penetration depth depend on the Z of the target material and the initial energy $E_0$. The energy loss of transmitted electrons at the average penetration depth is equal to that of backscattered electrons. A connection between the penetration parameter, the backscattering fraction, and the energy dissipation $\bar{E}/E_0$ of fast electrons in solid materials is given. (auth)

**13793** SODIUM ACTIVATION BY FISSION NEUTRONS; INTERCOMPARISON OF DIFFERENT ANTHROPOMORPHOUS PHANTOMS. Douellou, D.; Evrard, J. (CEA Centre d'Etudes de Valduc, 21 - Is-sur-Tille (France)). Radioprotection; 9: No. 4, 271-288(1974). (In French)

Three different phantoms were irradiated by means of fission neutrons. The resultant sodium activation was studied by measuring $^{24}Na$ activity in whole body, in symmetric parts of the body and in deeper organs. These results gave the occasion of comparing the tested phantoms. (FR)

**13794** ENERGY LOSS STRAGGLING OF PARTICLES PASSING THROUGH A THIN ABSORBER. Dellagi, M. (Tunis Univ. (Tunisia). Dept. de Physique). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 17, 547-549(5 May 1975). (In French)

Energy loss straggling distributions are solutions of an integro-differential equation of transport, the Green's function of which is given as an Edgeworth series. The energy loss can be interpreted on a basis of shot effect. The correlation with Markov process and Kolmogorov equation is given. (FR)

**13795** EVALUATION OF HEAVY ION ENERGY LOSSES IN Si BY CHANNELING. Grob, J. J.; Grob, A.; Siffert, P. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Lab. de Physique des Rayonnements et d'Electronique Nucleaire). Vide; 29: No. 173, 374-379(Sep 1974). (In French)

It is shown that the lack of pulse height appearing when a heavy ion is detected directly by a semiconductor diode can be broken down by ion channeling into two contributions, one due to energy losses by nuclear collisions and the other to the superficial dead layer of the detector. It was possible to observe how collisions divide into interactions, either nuclear or electronic, for silicon and nitrogen ions entering silicon in an energy range from 300keV to 2MeV. Besides proof of the LSS theory, an influence of anisotropy in the atomic density following the direction of ion penetration was demonstrated. (FR)

**13796** CLOSE COLLISIONS OF FAST POSITRONS AND ELECTRONS WITH STRING ATOMS. Kudrin, V. V.; Vorobiev, S. A. (Tomskij Politekhnicheskij Inst. (USSR)). pp 397-401 of Session d'etudes sur la canalisation des particules. Saclay, France; Institut National des Sciences et Techniques Nucleaires (1975).

From meeting on particle channeling; Saclay, France (27 May 1974).

The penetration behavior of 20 MeV electrons in a <100> MgO single crystal was studied. In the calculations the early described version of the binary collision model based on the classical mechanics was used. The classical theory has been shown to be valid for the scattering of fast electrons in the crystal lattice. For the comparison with the behavior of positive particles, the scattering of 20MeV positrons under the same conditions was simulated. (FR)

**13797** ENERGY LOSSES OF A RELATIVISTIC PARTICLE NEAR THE INTERFACE OF TWO MEDIA. Chechin, V. A. (Lebedev Inst. of Physics, Moscow). Dokl. Akad. Nauk SSSR; 221: No. 4, 813-815(1 Apr 1975). (In Russian).

The subject is developed mathematically. The change in energy loss when particles from a dense substance enter a gas leads to a 30% decrease of the energy loss in the gas near the interface. Upon transition from a gas to a dense substance, calculations show a suppression of the density effect in thin platelets, as is known from transition radiation theory. (TTT)

**13798** COHERENT EMISSION OF TRANSITION RADIATION IN PERIODIC RADIATORS. Fabjan, C. W.; Struczinkski, W. (European Organization for Nuclear Research, Geneva (Switzerland)). Phys. Lett., B; 57: No. 5, 483-486(4 Aug 1975).

Measurements have been made of X-ray transition radiation spectra, which were produced by relativistic electrons traversing periodic stacks of mylar and lithium foils. The dependence of the spectral yield on the stack parameters and on the momentum of the electrons establishes the influence of long-range coherence in the emission of transition radiation. (auth)

**13799** PATH-LENGTH DISTRIBUTION OF ULTRARELATIVISTIC CHARGED PARTICLES IN AN INHOMOGENEOUS SCATTERING MEDIUM. Berman, G. P. (Novosibirsk State Univ., USSR). Sov. Phys.–Tech. Phys. (Engl. Transl.); 20: No. 2, 276-277(1975).

Translated from Zh. Tekh. Fiz.; 45: No. 2, 440-443(Feb 1975).

A method is described for finding the path-length distribution of ultrarelativistic charged particles in an inhomogeneous scattering medium. The explicit form of the distribution function is found for a particular case of inhomogeneity; the transition to the homogeneous case is shown. (auth)

**13800** LINEAR-ENERGY-TRANSFER SPECTRA OF LONG-WAVE X RADIATION. Kolotilova, V. G.; Popov, V. I.; Savinskii, A. K. (Inst. of Biophysics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 18: No. 2, 411-414(1975).

Translated from Prib. Tekh. Eksp.; 18: No. 2, 73-75(1975).

The results of measurements of the dosage spectra are presented for the linear energy transfer of x radiation generated at voltages of 12 and 30 kV. Spectra were obtained by means of a set of tissue-equivalent low-efficiency Geiger counters. The measured linear-energy-transfer spectra are compared with the spectra obtained under the same irradiation conditions by calculation. (auth)

**13801** PROTON STOPPING POWERS: BINARY ENCOUNTER CALCULATIONS BASED ON ACCURATE SPEED DISTRIBUTIONS FOR TARGET ELECTRONS. Newton, M. D. (Brookhaven National Lab., Upton, N. Y. (USA)); Lucas, L. L.; Root, J. W. (California Univ., Davis (USA). Dept. of Chemistry). Chem. Phys. Lett.; 34: No. 3, 552-556(1 Aug 1975).

Atomic and molecular electronic stopping powers for medium energy protons (approximately 10 keV–10 MeV) have been calculated using the binary-encounter approximation in conjunction with (1) either an energy or maximum impact parameter cut-off based on minimum excitation energies; and (2) ab initio electronic speed distributions. The maximum impact parameter approach yields good agreement with experiment for inert gases and closed-shell polyatomic molecules comprised of first row atoms. (auth)

**13802** ESTIMATED W-VALUES FOR NEGATIVE PIONS IN NITROGEN AND ARGON. Turner, J. E.; Wright, H. A.; Hamm, R. N. (Oak Ridge National Lab., TN). Health Phys.; 29: No. 5, 792-794(Nov 1975).

Estimates of W, the average energy required to produce an ion pair, for the gases $N_2$ and Ar, based on a combination of calculations and available experimental data are presented. Values of $W_C$, $W_N$, and $W_O$ representing the average energies required to form an ion pair in $N_2$ or Ar by the ions produced when a stopped negative pion is captured by a carbon, nitrogen, or oxygen nucleus are tabulated together with the values for $W_{tissue}$ which represent the energies when the capturing nuclei C, N and O are present in the relative atomic abundance with which they occur in soft tissue. This work indicates that the energy dependence of W amounts to only about 0.1% in measuring the dose delivered in tissue by stopped pions. The calculations also imply that W changes by only about 1% between the plateau and peak regions. (UK)

**13803** SPRAVOCHNIK PO YADERNOI FIZIKE. (Nuclear Physics Handbook). Nemets, O. F.; Gofman, Yu. V. Kiev; Izdatel'stvo Naukova Dumka (1975). 415p.

This handbook contains basic properties of all stable isotopes and the most frequently used radioactive isotopes. Formulas and tables characterizing the passage of electrons, light and heavy ions, and gamma-quanta through different chemical elements over a wide range of bombarding particle energies are given. Formulas for nonrelativistic kinematic nuclear reactions and tables for calculating the angles and cross sections of laboratory systems of coordinates in the system of the center of inertia are presented. Nuclear reactions are classified, detectors for ionizing radiations are described, and practical recommendations on activation analysis are presented. The book is designed for physics, biologists, doctors, chemists, engineers, and workers in other specialties using ionizing radiation. (tr-auth)

**13804** DETERMINATION OF PROTON RANGES. Zykov, I. K.; Varyushchenko, S. B.; Dmitrov, G. N. Sov. J. At. Energy (Engl. Transl.); 33: No. 6, vp.(Dec 1972).

Translated from At. Energy. (USSR); 33: No. 3, 987(Dec 1972). This is a summary of paper No. 629/6820 with full copy held at TIC.

Ranges of protons of energy $E_p$ in matter are computed from the relation $R(E_p,X) = A_X/2Z_X\, R(E_p,C)k(y_X)$. Here $A_X$ and $Z_X$ are the mass number and atomic number of the stopping medium; $R(E_p,C)$ is the range of protons of energy $E_p$ in carbon; $k(y_X) = 1 + a_1y_X + a_2y_X^2 + a_3y_X^3$; $y_X = \log (I_X/I_C)$ where $I_X$ and $I_C$ are the ionization potentials of the stopping material and carbon. The coefficients $a_1$, $a_2$, and $a_3$ have been calculated as functions of the energy $E_p$ from 10 to 500 MeV. Using this procedure the ranges of 10-500 MeV protons were calculated for such materials as Plexiglas, quartz glass, alloy IMI-680, titanium, lithium hydride, asbestos textolite, boron carbide, ablative material (30% phenol + 70% $SiO_2$), biological tissue, etc. Values of proton ranges in aluminum, copper, and lead obtained by the present method and by integration [1] are presented for comparison. They differ by less than 1% over the whole energy range. (auth)

## Radiation Protection Standards

**13805** (CONF-741040-P1, pp 449-451) ROLE AND TRAINING OF APPLIED PHYSICISTS IN CLINICAL MEDICINE. Kelsey, C. A. (Univ. of Wisconsin, Madison). 1974.

From third conference on the use of small accelerators; Denton, Texas, USA (21 Oct 1974).

In proceedings of the third conference on application of small accelerators. Volume I, The use of small accelerators in research and teaching. (North Texas State Univ., Denton (USA)).

**13806** "MISCELLANEOUS SOURCES" OF RADIATION IN THE UNITED KINGDOM. Wrixon, A. D. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 13, 12-15(Oct 1975).

A historical survey of developments preceding the transfer in 1970 of advisory responsibility for the control of miscellaneous sources to the National Radiological Protection Board (NRPB) is followed by a description of the current administrative and legal situation in the U.K. The term "miscellaneous sources" is now used to mean articles incorporating radioactive materials, or emitting ionizing radiations, which are available to the general public (i.e. consumer products) or are used in public places. Examples of miscellaneous sources on which the NRPB has given advice include anti-static brushes containing microspheres of $^{210}Po$ and used for cleaning records and photographic negatives, dental porcelains, incorporating uranium as a fluorescing agent, and various luminized watches and compasses. Although miscellaneous sources are not at present subject to statutory control, U.K. membership of the EEC should change this situation. The applications of the radiological protection standards already defined for different devices are discussed. These standards have helped to establish a consistent approach on both a national and an international level. The problems presented by existing sources already in the hands of the general public have served to emphasize the need for early definition of detailed radiological protection standards. (UK)

**13807** CONCORDE AND COSMIC RADIATION. Delahaye, R. P. (Hopital d'Instruction des Armees Begin, 94 - Saint-Mande (France)); Kaiser, R. (Centre National de la Recherche Scientifique, 67 - Strasbourg (France). Centre de Recherches Nucleaires); Francois, H; Portal, G. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Service Technique d'Etudes de Protection et de Pollution Atmospherique). 111: Presse Therm. Clin; No. 3, 161-163(1974). (In French)

Airflights between 15 and 20km require good knowledge of the environment as regards cosmic radiation. A number of research programs on board Concorde prototypes have shown that dose intensities for galactic cosmic radiation varied from 0.5 to 1.6mrem/h according to latitude. Solar flares resulting in possible excess exposures between 15 and 20km should be considered by responsible authorities - compulsory environmental detector, determination of radiation dose levels not to be exceeded, specification of operational procedures of descent at lower altitudes. (FR)

## Radiation Source Calibration and Standardization

**13808** EVOLUTION OF UNITS AND STANDARDS IN IONIZING RADIATION METROLOGY. LeGallic, Y.; Legrand, J.; Guiho, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Lab. de Metrologie des Rayonnements Ionisants). Bull. Inf. Bur. Natl. Metrol.; 6: No. 20, 55-61(Apr 1975). (In French)

The evolution of the metrology of ionizing radiations is discussed. New units which would permit this field to be better defined are considered. The concept of primary standards is developed. The state of the art is described including primary standards in metrology of activity and in dosimetry. (FR)

**13809** ENERGY SPECTRUM OF RELATIVELY LARGE KILOCURIE $^{60}Co$ SOURCE USED IN AGRICULTURE. Visser, C. J. (Fruit and Fruit Tech. Research Inst., Stellenbosch, South Africa); Mouton, W. L. Int. J. Appl. Radiat. Isot.; 26: No. 10, 573-578(Oct 1975).

Radioactive $^{60}Co$ decays by the emission of $\beta$-particles of maximum energy about 310 keV and $\gamma$-rays of energy 1.17 and 1.33 MeV. Due to the interaction of the $\beta$- and $\gamma$-radiation with the source itself and also its surrounding capsule and shielding, the energy spectrum of the electromagnetic radiation from the source should consist of two peaks superimposed on a continuous background. Measurements performed to obtain the shape and intensity of this energy degraded spectrum, which can be important when the source is used for irradiation purposes, are presented. (auth)

## Shielding Calculations and Experiments

13810 NEW DESIGN POLICY FOR PROTECTIVE BARRIERS IN DEPARTMENTS OF X-RAY DIAGNOSIS. Gifford, D. (Bristol General Hospital, Eng.). Br. J. Radiol.; 48: No. 574, 851-857 (Oct 1975).

In order to calculate the thicknesses of protective barriers required in departments of radiodiagnosis for walls, floors, ceilings, protective screens, etc., it is necessary to make an assessment of work load and occupancy factor in each direction. In order to ensure that barriers are safe, it is customary to assume that all the radiological procedures are carried out at the greatest kVp value used in the room in question, and to look up the necessary thicknesses from prepared tables. In fact, only a small fraction of work load is carried out at the highest kilovoltage, and also it is found that a considerable fraction of the total work load is directed downwards. A computer program has been written to use data available from comprehensive analyses of work load broken down into suitable kVp intervals. As the cost of providing the necessary protective barriers can be anything from a few hundred pounds to several thousand pounds, the use of exact values for work load separated into kVp ranges for each direction can lead to substantial savings in cost amounting to hundreds of pounds per room whilst still satisfying the requirements of the Code of Practice for the Protection of Persons against Ionizing Radiations arising from Medical and Dental Use (HMSO, 1972). Departmental surveys were carried out to establish the distribution of work load in kVp and direction, and also to ascertain dosage levels to the staff and within existing rooms. The results showed that in practice the doses were such that the reduced barriers found by the method described would be entirely satisfactory. (auth)

# PHYSICS (THEORETICAL)

## General

*Refer also to abstracts 12986 and 13101.*

**13811** (CEA-N-1791, pp 39-41) EXPERIMENTAL TEST OF THE PREDICTIONS OF THE LOCAL HIDDEN VARIABLE THEORIES. Lamehi-Rachti, M.; Mittig, W. [nd]. (In French)
In Department of Nuclear Physics. Progress report 1 October 1973-30 September 1974.
Bell showed (Bell's inequality) that local hidden variable theories lead to predictions in contradiction with quantum mechanics. This was tested in low energy proton-proton scattering by the simultaneous measurement of the polarization of the two protons. The results are in agreement with quantum mechanics and thus in contradiction with the inequality of Bell. (FR)

**13812** (USIP-75-16) VISUAL DESCRIPTION OF 2-COMPONENT SPINOR CALCULUS. Hellsten, H. (Stockholm Univ. (Sweden). Fysiska Institutionen). Jul 1975. 24p. Dep. NTIS (US Sales Only) $3.50.
Spinors and algebraic operations on them are given a visual description. This structural interpretation of spinors is to be contrasted with the well known quadratic relation between spinors and visual objects (vectors, flagpoles). The interpretation is founded on the observation that the product between two successive rotations half a turn along the legs of an angle will be a rotation through twice that angle. This observation makes it possible to explain visually the doubling of angles, which occurs when vectors are constructed out of spinors. It is seen that, using this explanation, spinor calculus can, in close analogy to 3-dimensional Euclidean vector calculus, be given a purely visual meaning. (auth)

**13813** WHY CONTINUE WITH NUCLEAR PHYSICS. Bishop, G. R. (Univ. of Glasgow). Riv. Nuovo Cim.; 5: No. 2, 137-154(1975).
The discussion of the study of nuclear physics covers nuclear physics as a part of academic physics, nuclear models, nuclear physics and elementary particle physics, interchange of techniques, the development of nuclear-structure physics, the shell model, collective effects in nuclear models, nuclear-matter calculations, nuclear reactions, and the nucleus as a quantum-mechanical laboratory. (JFP)

**13814** ABANDONMENT OF SIMULTANEITY. Noyes, P. Theoria to Theory; 9: 23-32(1975).
Some recent investigations in linguistics, communication, and social organization have found that progress can be made only by abandoning the concept of simultaneity in favour of a multi-component hierarchical description of overlapping times. It is suggested that the same approach might offer a clue to the solution of the problem of joining relativity theory to quantum mechanics, which has resisted more conventional approaches for forty years. (auth)

**13815** SOME GENERALIZATIONS OF EINSTEIN REIMANNIAN SPACES. Kuz'mina, G. M. (Moscow Engineering Physics Inst.). Mat. Zametki; 16: No. 4, 619-622(Oct 1974). (In Russian)
A special class of Riemannian structures which are called generalized-einsteinian structures of index 2e, of which Einstein spaces are a special case, is introduced. It is proved that these structures are stationary for functions introduced on the family of Riemannian structures of the compact manifold of H. Weil. This result solves a problem of M. Berger. Examples of generalized-einsteinian structures with respect to all indices are homogeneous compact Riemannian spaces with irreducible isotropy group, and products of these spaces. References 2 Western. (JPRS)

**13816** LATTICE THEORY, GROUPS, AND SPACE. Drieschner, M. pp 55-69 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).
From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.
The concept of object is considered. Then the idea behind efforts to understand space is treated with respect to groups. (JFP)

**13817** THREE DIMENSIONAL QUANTUM PROPOSITION SYSTEMS. Greechie, R. J. (Kansas State Univ., Manhattan). pp 71-83 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).
From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.
Proposition systems are discussed which do not admit a representation L(V, D) of all $\phi$-closed subspaces of a vector space V over a division ring D where $\phi$ is a definite sesquilinear form corresponding to an anti-automorphism on D. These systems are of dimension three and correspond to orthocomplemented non-Desaryuesian projective planes. The principle interest in these structures lies in the axiomatic development. They provide examples of proposition systems which are not quantum logics of proposition systems which are quantum logics and admit dispersion free states and of proposition systems which have predescribed automorphism groups. The work is essentially expository, and no new results are found. (JFP)

**13818** SYMPLECTIC STRUCTURE AND QUANTIZATION. Simms, D. J. (Trinity Coll., Dublin). pp 247-252 of Quantum Theory and the Structures of Time and Space. Castel, L. (ed.). Munich; Carl Hanser Verlag (1975).
From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.
The treatment of symplectic structure and quantization also includes symplectic manifolds and mechanics. (JFP)

**13819** N-VARIABLE RATIONAL APPROXIMANTS AND METHOD OF MOMENTS. Alabiso, C.; Butera, P. (Stanford Univ., CA). J. Math. Phys. (N.Y.); 16: No. 4, 840-845(Apr 1975).
The method of moments is applied to pairs of linear permutable self-adjoint operators A and B in a Hilbert space H. An approximate expression for the diagonal matrix elements of the operator $(1 - wA - zB)^{-1}$, where w, z are complex numbers, is taken as a guide to the definition of rational approximants from general formal power series in two variables. With an operator convergence theorem in a certain Hilbert space as a basis, the convergence of the approximants to analytic functions of two complex variables with the integral representation G(w,z) equals integralintegral d sigma(alpha,beta)/(1 - w alpha - z beta) is proved, under suitable restrictions on the positive measure sigma(alpha,beta). The same approximation scheme can also be applied to the diagonal matrix elements of the operator $[(1 - wA)(1 - zB)]^{-1}$, leading to a different rational approximant which is proved to converge to functions with the integral representation G(w,z) equals integral integral d sigma(alpha,beta)/(1 - w alpha)(1 - z beta). In both cases the convergence is uniform on appropriate compact subsets of $C^2$. The extension to the n-dimensional case is straightforward for both approximants. The connections with a standard variational principle are also briefly discussed. (auth)

**13820** GENERALIZED MASTER EQUATIONS "EXACT IN THE BORN APPROXIMATION". Bonifacio, R. (Univ. Milan); Lugiato, L. A. Lett. Nuovo Cim.; 14: No. 14, 532-536(6 Dec 1975).
A theorem is given allowing one to construct generalized master equations exact in the Born approximation in which the higher-order terms in the Born expansion vanish exactly. (JFP)

**13821** SYSTEMS OF TWO RELATIVISTIC PARTICLES. Droz-Vincent, P. (Paris-6 Univ., 75 (France)). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 17, 1169-1172(5 May 1975). (In French)
For a simple choice of the generating Hamiltonians, evolution equations can be explicitly integrated. The general solution is found for the equation relating the positions and the canonical variables. (FR)

**13822** INVARIANT OPERATORS OF INHOMOGENEOUS UNITARY GROUP. Rafique, M.; Shah, K. T. (International Centre for Theoretical Physics, Trieste (Italy)). Ann. Inst. Henri Poincare, Sect. A; 21: No. 4, 341-345(1974).
Let $t_n + u(n)$ be the semi-direct sum of an abelian Lie algebra with the Lie algebra of unitary group U(n). It is shown that an invariant of $u(n + 1)$ is also an invariant of $t_n + u(n)$ if $\phi : t_n + u \to u(n + 1)$ is an expansion. Sixth-order invariants of semi-direct sum algebra are calculated by this method. (FR)

**13823** NEW FORMULATION OF BOLTZMANN'S EQUATION. Pichon, G. (Paris-13 Univ., 93 - Saint-Denis (France)). pp 309-312 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974). (In French)
From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).
A new and relativistic formulation of Boltzmann's equation is presented. (FR)

**13824** EIKONAL APPROXIMATION IN THE CONFIGURATION SPACE. Bechler, A. (Warsaw Univ. (Poland). Instytut

Fizyki Teoretycznej). Phys. Lett., A; 54: No. 1, 3-4(11 Aug 1975).

Conditions of applicability of the eikonal approximation for the nonrelativistic one-particle propagator are investigated. It is shown that the direction of eikonalization cannot be chosen arbitrarily. (auth)

**13825** SOME SIMPLE REMARKS ON VARIATIONAL BOUNDS IN FADDEEV-TYPE FORMALISMS. Goldflam, R.; Kouri, D. J. (Houston Univ., Tex. (USA). Dept. of Physics). Chem. Phys. Lett.; 34: No. 3, 594-596(1 Aug 1975).

A bound on the energy obtained from the differential equation forms of Faddeev-type equations is derived. The procedure is based on the standard variation principle for the Schrodinger equation plus the observation that the ordinary Schrodinger wavefunction equals the sum of the Faddeev-type "channel wavefunctions." (auth)

**13826** MAXWELL'S EQUATIONS IN RIEMANN-CARTAN SPACE-$U_4$. Prasanna, A. R. (Bonn Univ. (F. R. Germany). Inst. fuer Theoretische Kernphysik). Phys. Lett., A; 54: No. 1, 17-18(11 Aug 1975).

Starting with the invariant form of Maxwell equations the covariant set of Maxwell equations have been derived in a $U_4$ referred to the most general frames. (auth)

**13827** PARTIAL WIDTHS OF FIXED GENERALIZED SENIORITY SPECTRAL DISTRIBUTIONS. Quesne, C. (Brussels Univ. (Belgium)). Phys. Lett., B; 57: No. 5, 422-424(4 Aug 1975).

Analytic expressions are derived for the partial widths of the fixed generalized seniority spectral distributions, using an expansion of the hamiltonian in terms of irreducible tensors with respect to both symplectic and quasispin groups. (auth)

**13828** INDUCED COMPTON SCATTERING BY RELATIVISTIC PARTICLES. Blandford, R. D.; Scharlemann, E. T. (Cambridge Univ. (UK). Inst. of Theoretical Astronomy). Astrophys. Space Sci.; 36: No. 2, 303-317(Sep 1975).

Induced Compton scattering by independent relativistic particles in a radiation field is considered from both quantum mechanical and classical viewpoints. Quantum mechanically, the particle recoil causes an imperfect cancellation of the induced scattering rates between pairs of photon states. This results in a net energy transfer from the radiation field to the particle. Classically, the electrodynamical effects are manifestations of non-linear coupling between different wave amplitudes in the equation of motion. The results from these two approaches are related and shown to be equivalent. (NL)

**13829** VISCOUS DAMPING OF NONLINEAR MAGNETO-ACOUSTIC WAVES. Adam, J. A. (UKAEA Research Group, Abingdon. Culham Lab.). Astrophys. Space Sci.; 36: No. 2, 479-487(Sep 1975).

The motivation for the present work is discussed, and the nonlinear Burger's equation is derived for wave propagation in a compressible unstratified viscous fluid permeated by a magnetic field (initially constant), using the reductive perturbation method of Taniuti and Wei (1968). An analytic solution of the equation is given (after Sakai, 1972) and the angular behavior is shown for certain parameters describing the nonlinearity and damping of the system, for both fast- and slow-mode disturbances. (NL)

**13830** GENERALIZED PERTURBATION THEORY. Moiseyev, N.; Katriel, J. (Technion-Israel Inst. of Tech., Haifa). Phys. Lett., A; 54: No. 2, 125-127(25 Aug 1975).

A generalized perturbation theory, embedding the Brillouin-Wigner and the Rayleigh-Schroedinger procedures as special cases, is proposed. It enables the formulation of the expansion for the helium sequence so that the whole correction is incorporated in the second order term. (NL)

**13831** RADIAL DISTRIBUTION FUNCTION FOR FERMI LIQUIDS IN JASTROW THEORY. Krotscheck, E. (Hamburg Univ. (F.R. Germany). 1. Inst. fuer Theoretische Physik). Phys. Lett., A; 54: No. 2, 123-124(25 Aug 1975).

Closed expressions are derived for the radial distribution function of Fermi systems which have their analogue in the hypernetted chain equations in classical statistics. Consequences of long range Jastrow correlations on the features of the static structure function are discussed. (NL)

**13832** PROPOSED EXPERIMENT TO TEST SEPARABLE HIDDEN-VARIABLE THEORIES. Aspect, A. (Paris-11 Univ., 91-Orsay (France)). Phys. Lett., A; 54: No. 2, 117-118(25 Aug 1975).

An experimental scheme is proposed to test hidden-variable theories that satisfy the principle of separability of Einstein. (NL)

**13833** CONSTRUCTION OF THE HYPERSPHERICAL FUNCTIONS FOR THE QUANTUM MECHANICS OF THREE PARTICLES. Mayer, H. (Univ., Freiburg i.B.). J. Phys., A (London); 8: No. 10, 1562-1574(Oct 1975).

A solution of the differential equation for the grand angular momentum in hyperspherical coordinates is given by simple algebraic means avoiding complicated recurrence formula. (auth)

**13834** QUANTUM DYNAMICS OF A SOLVABLE NONLINEAR CHIRAL MODEL. Lakshmanan, M.; Eswaran, K. (Madras Univ.). J. Phys., A (London); 8: No. 10, 1658-1669(Oct 1975).

The quantum mechanical analogue of a classical nonlinear system is shown to be exactly solvable and its energy levels and eigenfunctions are obtained completely. The symmetric version of this isotriplet model is the SU(2) ⊗ SU(2) chiral invariant Lagrangian in the Gasiorowicz-Geffen coordinates. The radial part of the classical equation of motion (in both the symmetric and nonsymmetric cases) admits simple harmonic bounded solutions and the bound state energies of the quantized system show a linear dependence on the coupling parameter λ. It is shown that the Bohr-Sommerfeld quantization procedure reproduces the form of the correct bound state energy levels while a perturbation theoretic treatment gives the exact energy expressions. Arguing along the lines that the Hamiltonian be invariant under the action of the underlying internal symmetry group, the ordering problem that arises in the quantum mechanical case is overcome. (auth)

**13835** QUANTUM MECHANICAL AND SEMICLASSICAL DESCRIPTION OF A TWO-DIMENSIONAL FISSION MODEL. Massmann, H.; Ring, P.; Rasmussen, J. O. (California Univ., Berkeley (USA). Lawrence Berkeley Lab.). Phys. Lett., B; 57: No. 5, 417-421(4 Aug 1975).

The penetration through a two dimensional fission barrier is investigated by a fully quantum mechanical coupled channel calculation and by a new semiclassical method. One finds a quantitative agreement. (auth)

## Quantum Field Theories

*Refer also to abstracts 13252, 13304, 13415, 13819, and 13877.*

**13836** (GIFT-7/75) P, C, T, Θ IN QUANTUM FIELD THEORY. Four Lectures. de Azcarraga, J. A. (Grupo Interuniversitario de Fisica Teorica de Altas Energias (GIFT), Zaragoza (Spain)). 1975. 87p. Dep. NTIS (US Sales Only) $5.00.

An introduction is provided to the formalism of P, C, T, Θ in Q. F. T. The approach presented is mainly theoretical, although reference to experimental results is occasionally made; the "particle aspect" is emphasized throughout. The treatment of the different discrete symmetries is similar: after briefly describing the meaning of the operation, its formalism is introduced, and then some applications and tests are considered. Several simple exercises are also proposed. Notation, conventions, and some other results used in the text are collected. (auth)

**13837** (IFA-FT-110-1974) QUALITATIVE STUDY OF THE RENORMALIZATION GROUP EQUATIONS. Ghika, G.; Visinescu, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 21p. INIS.

The main purpose of the paper is to study the renormalization group equations for the effective mass and the effective coupling constant of a renormalizable field theory characterized by a single coupling constant and a single mass. It is shown that the trajectories of the system of differential equations are of the parabolic and/or hyperbolic type. The elliptic and closed trajectories are absent and consequently there are no theories ultraviolet and infrared free at the same time. The bifurcation of the critical points is derived varying the space-time dimensions around those of the physical systems. Finally, some remarks are made concerning the Liapunov asymptotic stability for the renormalization group equations in the case of an arbitrary number of masses and coupling constants. (auth)

**13838** (ITP-75-60R) SOLUTION OF THE DYSON EQUATIONS IN THE $\alpha(\alpha L_m)^p(\alpha L_m)^l$ APPROXIMATION FOR THE FERMION GREEN'S FUNCTIONS IN TWO-FERMION ELECTRODYNAMICS WITH BROKEN SYMMETRY. Fomin, P. I.; Shapovalov, V. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 16p. (In Russian). Dep. NTIS (US Sales Only) $3.50.

The renormalized Dyson equations for the fermion Green's functions in two-fermion quantum electrodynamics with spontaneous breakdown of isoleptonic symmetry are solved in the "five-vertex" approximation. The $\alpha(\alpha L_m)^p(\alpha L_m)^l$ -asymptotics of the fermion Green's functions are defined. (auth)

**13839** (ITP-75-61R) $\alpha(\alpha L_m)^p(\alpha L_m)^l$ -ASYMPTOTICS OF VERTEX FUNCTIONS IN TWO-FERMION ELECTRODYNAMICS

WITH BROKEN SYMMETRY. Fomin, P. I.; Shapovalov, V. V. (AN Ukrainskoj SSR, Kiev. Inst. Teoreticheskoj Fiziki). 1975. 26p. (In Russian). Dep. NTIS (US Sales Only) $4.00.

The solutions of the renormalized Dyson equations for vertex functions of the two-fermion quantum electrodynamics with the broken isoleptonic symmetry are found in the "five-vertex" approximation. The so-called $\alpha(\alpha L_m)^p \cdot (\alpha L_m)^l$ -asymptotics of renormalized vertex functions are found. (auth)

**13840** (JINR-P1,2-8529, pp 39-72) SPECIAL RELATIVISTIC THEORY OF ANISOTROPIC SPACE-TIME. Bogoslovskii, G. Yu. (Moscow State Univ.). 1975. (In Russian)

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The expression for intervals in anisotropic space events is established. The 8-parametric group of linear transforms of the coordinates of the event from one inertial reference system to another and the transforms of time intervals and space volumes are found. Equations of the mechanics of anisotropic space are constructed, and it is shown that in the new theory the Einstein 3-speed summation law remains valid. The Maxwell equations in anisotropic space-time maintain their invariance, however the electromagnetic field and current are transformed by other laws. (JSR)

**13841** (JINR-P1,2-8529, pp 159-166) PROPERTIES OF ASYMPTOTIC FIELDS IN THE QUANTUM SCATTERING THEORY. Dadashev, L. A.; Kuliev, V. Yu. (Inst. of Physics, Baku). 1975. (In Russian)

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The possibility of interpreting the quantum field theory in terms of particles is based on the inclusion of asymptotic conditions. These conditions necessary for a corpuscular interpretation for a model of the scattering theory and the subsequent limitation of the space of the model state are derived. (JSR)

**13842** (JINR-P1,2-8529, pp 544-573) QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES. Fainberg, V. Ya. (Lebedev Inst. of Physics, Moscow). 1975. (In Russian)

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

The purpose of the present lecture is to become acquainted with new results and ideas in the investigation of problems of internal closure of quantum electrodynamics. The specifics of finite renormalization, consequences of asymptotic renormalization invariance, and the electrodynamics of Baker, Johnson, and Adler are discussed. (JSR)

**13843** (JINR-P1,2-8529, pp 574-582) MATRIX ELEMENTS OF QUANTUM ELECTRODYNAMICS. Fedorov, F. I. (Inst. of Physics, Minsk). 1975. (In Russian)

From seminar on actual problems of elementary particle physics; Sochi, USSR (10 Oct 1974).

In international school-seminar on actual problems of elementary particle physics.

A new approach is presented which makes it possible to simplify the calculation of matrix elements and differential cross sections of different processes of electrodynamics and to explain some of their universally general properties. (JSR)

**13844** (RL-75-073) QUANTUM ELECTRODYNAMICS: TRANSLATIONS OF FOUR PAPERS BY HEISENBERG, DIRAC, AND WEISSKOPF. Smith, P. F. (ed.). (Science Research Council, Chilton (UK). Rutherford Lab.). May 1975. Translated by J. B. Sykes. 75p. Dep. NTIS (US Sales Only) $5.50.

Separate abstracts were prepared for the four translations presented. (JFP)

*For abstracts of individual papers see: 13269-13271, and 13845.*

**13845** (RL-75-073, pp D.1-D.30) ELECTRODYNAMICS OF THE VACUUM ON THE BASIS OF THE QUANTUM THEORY OF THE ELECTRON. Weisskopf, V. May 1975. Translated from Kgl. Dan. Vidensk. Selsk., Mat-Fys. Medd.; 14: No. 6, 3-39 (1936).

In quantum electrodynamics.

The modifications introduced into the electrodynamics of the vacuum by Dirac's theory of the positron are considered. The behavior of the vacuum can be described unambiguously by assuming the existence of an infinite number of electrons occupying the negative energy states, provided that certain well defined effects of these electrons are omitted, but only those to which it is obvious that no physical meaning can be ascribed. The results are identical with these of Heisenberg's and Dirac's mathematical method of obtaining finite expressions in positron theory. A simple method is given of calculating the polarizability of the vacuum for slowly varying fields. (auth)

**13846** INVARIANT QUANTIZATION, SCALE SYMMETRY, AND EUCLIDIAN FIELD THEORY. Jackiw, R. (Massachusetts Inst. of Tech., Cambridge). pp 30-61 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

A new method of quantization developed previously is reported, in which the surface of quantization is chosen to be the space-like hyperboloid $x^2$ = positive constant, and propagation of the system proceeds along the normal direction, from one hyperboloid to the next. It is shown that the formula for the S matrix in this approach, coincides with conventional Feynman-Dyson expression. An unexpected interpretation is given for anomalous dimensions. A new operator basis for Euclidean field theory was found. In two-dimensional theory it is found that the present ideas provide a bridge between the formalism of conventional field theory and that of the dual resonance model; explicitly the Virasoro algebra and the Hagedorn spectrum are found. (JFP)

**13847** INTRODUCTION TO SPONTANEOUS SYMMETRY BREAKDOWN AND GAUGE FIELDS. Coleman, S. (Harvard Univ., Cambridge, MA). pp 138-223 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755-.

Lectures are given as an introduction to the basic ideas of spontaneous symmetry breakdown and gauge fields. The review includes secret symmetries in classical field theory, secret renormalizability, functional integration (vulgarized) the Feynman rules for gauge field theories, and asymptotic freedom. (JFP)

**13848** GAUGE INVARIANCE IN GRIBOV'S FIELD THEORY AND THE INTERCEPT OF THE POMERON. Acharya, R.; Kleinert, H. (Univ., Berlin). Lett. Nuovo Cim.; 14: No. 11, 395-399 (15 Nov 1975).

It is shown how various problems in the Grikbov field can be avoided by postulating a gauge invariance with arbitrary real $\rho$ for the most general pomeron Lagrangian. (JFP)

**13849** UNIFIED QUANTUM THEORY. Finkelstein, D.; McCollum, G. (Yeshiva Univ., New York). pp 15-54 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).

From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.

A unified quantum theory is defined and proposed. In it the world is a net of quantum processes put together out of one indivisible quantum process represented by a finite-dimensional vertex, rather than particle-fields interacting in space-time. The main tool is a dynamical algebra, a formulation of Feynman diagrams as a distinct category combining quantum and topological elements. The language is illustrated by reformulating Newtonian and Schroedinger dynamics. The S matrix of such a theory is given in general by correspondence arguments, and was evaluated in some simple examples. Relativity and parity violation favor the vertex $\delta_B^A \delta_D^C$ of $2^4$ components. The space-time coordinate operator for that theory is given, and internal degrees of freedom are touched upon. The mass spectrum in a related theory is worked out to show what kind of calculations have to be done. One advantage of the quantum process description over a quantum space-time one is that energy is exactly conserved even when the fundamental unit of time $\tau$ is nonzero. (auth)

**13850** $\epsilon$-EXPANSION IN THE $U_n$ THIRRING MODEL. Wallace, D. J.; Weisz, P. H. (Univ. of Southampton, Eng.). Lett. Nuovo Cim.; 14: No. 13, 493-499(29 Nov 1975).

A generalized Thirring model describing a Fermi field with a U(n) symmetric self-interaction in $2 + \epsilon$ dimensions. First the U(n) Thirring model is introduced, the Callan-Symanzik $\beta$ functions exhibited, and it is pointed out that up to 1-loop contributions, the resulting coupling constant flow is gradient flow. The configuration of fixed points in an $\epsilon$ expansion is discussed. Finally, the conclusions are presented. (JFP)

**13851** OPERATORS OF CREATION-ANNIHILATION IN A MODEL OF STRONGLY NONLINEAR QUANTUM FIELD THEORY. Bauhain, M. (Univ., Paris). Lett. Nuovo Cim.; 14: No. 13, 475-479(29 Nov 1975).

A field theory is constructed in which the state number occurs as coefficient in the operator. In analogy with the formalism of

quantum field theory, which is based on the mathematical properties of Hermite polynomial, solutions of the equation of the harmonic oscillator, a field theory model is constructed from the properties of solutions of the equation $\Psi'' + [\alpha + \beta/\cosh^2 x]\Psi = 0$ which can be reduced to the Gengenbauer differential equation. (JFP)

13852 INTUITIVE APPROACHES TO FIELD THEORY. Weisskopf, V. F. (CERN, Geneva). pp 306-316 of Lepton and Hadron Structure. Vol. 12. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Italy (14 Jul 1974). See CONF-740731-.

Four examples of intuitive reasoning in field theory are presented. These are the Lamb shift, g-2 considerations, vacuum polarization, and asymptotic freedom. (JFP)

13853 VARIED YANG-MILLS FIELDS. Kerbrat-Lunc, H. (Lyon-1 Univ., 69 - Villeurbanne (France)). Ann. Inst. Henri Poincare, Sect. A; 21: No. 4, 333-338(1974). (In French)

The variation in the curvature tensor of a Yang-Mills defined on the curved $V_4$ space-time is calculated. The equations of a varied Yang-Mills field are derived and the Yang-Mills field commutator defined on the Minkowski space-time is evaluated. (FR)

13854 VERIFICATION OF AXIOMS FOR EUCLIDEAN AND RELATIVISTIC FIELDS AND HAAG'S THEOREM IN A CLASS OF $P(\phi)_2$-MODELS. Froehlich, J. (Harvard Univ., Cambridge, Mass. (USA). Lyman Lab. of Physics). Ann. Inst. Henri Poincare, Sect. A; 21: No. 4, 271-317(1974).

Axioms for Euclidean (Bose) fields are proposed and shown to suffice for the reconstruction of relativistic quantum fields satisfying the Wightman axioms. Those axioms are verified for a class of $P(\phi)_2$ models. They seem to provide a suitable framework for (Bose) field theories in two and three space-time dimensions. It is shown that the $P(\phi)_2$-interacting field in the infinite volume limit is not a (generalized) free field or a wick polynomial of a (generalized) free field. If $P_1$ and $P_2$ are two interaction polynomials in the region of convergence of the Glimm-Jaffe-Spencer cluster expansion then the corresponding infinite volume field theories are different, unless $P_1(xi) = P_2(\pm xi + a) + b$. (FR)

13855 PHASE INTEGRALS IN EQUIVALENCE CLASSES. Bergmann, P. G. (Syracuse Univ., N. Y. (USA)). pp 353-356 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

In a trial exploration of the discrete spectra of observables in a quantum theory of gravitation the author has previously suggested the construction of superclasses and the evaluation within them of closed-path phase integrals. Superclasses are sets of ordinary equivalence classes where the homology group is non-trivial. In this paper it is suggested that even the equivalence classes themselves, in general relativity, have a homology rich enough so that at least a few phase integrals can be formed without the need to construct superclasses. As a plausible example, let us take space times asymptotically flat at spatial infinity. It would appear that the total angular moment (if this integral is finite) can be quantified by the phase integral method. It is not known at present whether other discrete-spectrum observables can be studied by this method. (FR)

13856 DYNAMICAL SYMMETRY BREAKDOWN IN PURE YANG-MILLS FIELD THEORY. Englert, F. (European Organization for Nuclear Research, Geneva (Switzerland)); Frere, J. M.; Nicoletopoulos, P. (Brussels Univ. (Belgium). Faculte des Sciences). Nucl. Phys., B; 95: No. 2, 269-300(1 Sep 1975).

It is shown, in a simple approximation consistent with gauge invariance, that Yang-Mills fields associated with a compact simple Lie group, may acquire mass through their self interactions: this phenomenon leads to a breakdown of the original group symmetry and to an eigenvalue condition for the coupling constants of the self-interaction. It is conjectured, from an analysis of Feynman graphs, that these facts are still true in the full theory. The relevance to the problem of fermion interacting with Yang-Mills mesons is pointed out. (auth)

13857 SPACE-TIME PERTURBATIONS. Cohen, J. M.; Kegeles, L. S. (Pennsylvania Univ., Philadelphia (USA). Dept. of Physics). Phys. Lett.,A; 54: No. 1, 5-7(11 Aug 1975).

Scalar Debye potentials for neutrino, electromagnetic, and gravitational perturbations of space-times are derived by extending the Hertzian zero-rest-mass field potentials of Penrose to curved spaces. The scalar formulation provides a computational technique in many space-times of astrophysical interest. (auth)

13858 PHASE TRANSITIONS AND THE HIGH TEMPERATURE EXPANSION FOR THE REGGEON CALCULUS. Ellis, J.; Savit, R. (European Organization for Nuclear Research, Geneva (Switzerland)). Nucl. Phys., B; 94: No. 3, 477-500(18 Aug 1975).

A recently proposed lattice version of the reggeon field theory is studied. First a simple one-dimensional system possessing many of the features of the reggeon calculus (Ising model in an imaginary magnetic field) is solved. Surprisingly, the system is found to undergo a phase transition at a non-zero critical temperature, which, although of first order, obeys the universality and scaling laws previously postulated for the reggeon calculus. Returning to the full lattice theory, the machinery for performing a high temperature expansion is set up, and initial calculations carried out to order $T^{-3}$. In this order, best estimates for the critical indices $\eta$ and $\nu$ in the asymptotic elastic amplitude A (s,t) on the order of $(\ln s)^{\eta} f(t (\ln s)^{\nu})$ yield $\eta = 0(\frac{1}{2} \sim 1)$, $\nu = 0(1\frac{1}{2} \sim 2)$. Checks on the method, including comparisons with known Ising model results, are also discussed. (auth)

13859 REGGEON FIELD THEORY ON A LATTICE: A FORMULATION. Brower, R. C. (California Univ., Santa Cruz (USA)); Ellis, J.; Savit, R. (European Organization for Nuclear Research, Geneva (Switzerland)); Zakrzewski, W. J. (Durham Univ. (UK)). Nucl. Phys., B; 94: No. 3, 460-476(18 Aug 1975).

The principle of universality is taken from statistical mechanics and applied to the reggeon field theory. Following a pedagogical review of the implications of universality for the reggeon calculus, a lattice formulation of the reggeon field theory is presented and discussed. Scaling laws for the thermodynamic quantities of such systems are described and relations among critical indices are derived. These relations enable high-energy scattering behavior to be calculated using lattice methods. (auth)

13860 QUANTIZATION OF THE MASSIVE YANG-MILLS FIELD IN ARBITRARY GAUGES. Shizuya, K. (Tokyo Univ. (Japan). Dept. of Physics). Nucl. Phys., B; 94: No. 2, 260-268 (11 Aug 1975).

A general gauge formulation of the massive Yang-Mills theory is presented with emphasis on the fact that the massive Yang-Mills field is, like the massless counterpart, also a non-Abelian gauge field. (auth)

13861 REGGE BEHAVIOUR OF A SOLUBLE MODEL WITH ASYMPTOTIC FREEDOM. Lovelace, C. (Rutgers-the State Univ., New Brunswick, N. J. (USA). Dept. of Physics). Nucl. Phys., B; 95: No. 1, 12-52(25 Aug 1975).

The Bethe-Salpeter kernel is rearranged as an expansion in the effective coupling (of the renormalization group). In asymptotically free field theories, it now converges at large momenta, to give a "renormalized ladder" approximation. This is solved exactly at zero mass in the $\phi_4^3$ model. Unlike the old ladder, its Bjorken limit agrees with the Callan-Symanzik equations. However, the Regge limit disagrees. Regge trajectories accumulate at those j-values where the anomalous dimensions seem to diverge (planar Gribov-Pomeranchuk disease). In non-Abelian gauge theories, this should happen at $j = 1$. (auth)

13862 HIGHER ORDERS IN $N^{-1}$ IN THE GROSS-NEVEU MODEL. Schonfeld, J. F. (Princeton Univ., N. J. (USA). Joseph Henry Labs.). Nucl. Phys., B; 95: No. 1, 148-172(25 Aug 1975).

Higher-order terms are studied in the N expansion of the two-dimensional model field theory of Gross and Neveu. The quantity $M_0/2M_F - 1$ ($M_F$ is the fermion mass $M_0$ is the scalar bound-state mass) is conjectured to deviate from zero in $O(N^{-4})$. Order $N^{-1}$ corrections are found to leave unchanged both the symmetry-breaking, and the absence of zeroes of the Callan-Symanzik function $\beta$ for a real non-zero coupling constant. Behavior of $\beta$ for a complex coupling constant is altered considerably by the corrections; consequences are discussed. The following additional results are obtained: proof that the model is renormalizable without the necessity of additional interactions; construction of a perturbation theory in the asymmetric vacuum; proof of a lemma on fermion-antifermion thresholds in two dimensional space-time; derivation of closed formulae for arbitrary one-loop integrals in two-dimensional space-time. (auth)

13863 NEUTRAL CURRENTS AND THE HIGGS MECHANISM. Ross, D. A.; Vettman, M. (Rijksuniversiteit Utrecht (Netherlands). Instituut voor Theoretische Fysica). Nucl. Phys., B; 95: No. 1, 135-147(25 Aug 1975).

The consequences of assuming (i) weak and e.m. forces constitute a gauge field theory, and (ii) there are no heavy leptons, are investigated. Relative to the Weinberg model, introduction of

a general spontaneous symmetry breaking system leads to a theory with one extra free parameter, namely the neutral vector boson mass. Experimental consequences are indicated. A particular Higgs system containing two multiplets is studied in detail. It is noted that parameters may be chosen such that the cosmological constant is zero before as well as after spontaneous symmetry breakdown. (auth)

**13864** DUAL FIELD THEORY OF QUARKS AND GLUONS. Scherk, J.; Schwarz, J. H. (California Inst. of Tech., Pasadena (USA)). Phys. Lett., B; 57: No. 5, 463-466(4 Aug 1975).

The 10-dimensional space-time of the spinor dual model is interpreted as the product of ordinary 4-dimensional space-time and a 6-dimensional compact domain, whose size is so small that it is as yet unobserved. This leads to an SU(4) symmetry group with quarks in both a 4 and a $\bar{4}$ multiplet. (auth)

**13865** SIXTH ORDER CONTRIBUTION OF THE ELECTRON ANOMALOUS MAGNETIC MOMENT. Barbieri, R. (European Organization for Nuclear Research, Geneva (Switzerland)); Caffo, M. (Bologna Univ. (Italy). Istituto di Fisica); Remiddi, E. (Ecole Normale Superieure, 75 - Paris (France)). Phys. Lett., B; 57: No. 5, 460-462(4 Aug 1975).

The contribution to the anomalous magnetic moment of the electron due to a set of sixth order graphs with two crossed photon lines is evaluated analytically. The dimensional regularization is used to parametrize the spurious infrared divergences. (auth)

**13866** SCALING AND THE APPROACH TO SCALING IN REGGEON FIELD THEORY. Frazer, W. R.; Moshe, M. (California Univ., La Jolla, San Diego (USA). Dept. of Physics). Phys. Lett., B; 57: No. 5, 475-478(4 Aug 1975).

The problem of the approach to asymptotic scaling in Reggeon field theory is considered. A method of integration of the renormalization group equations is presented and the asymptotic scaling functions, as well as the corrections which occur at non-asymptotic energies are obtained. (auth)

**13867** LIMIT OF INFINITE TARGET MASS IN q.e.d. AND NON-ABELIAN GAUGE THEORIES. Kim, K. J. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F. R. Germany)). Phys. Lett., B; 57: No. 5, 470-474(4 Aug 1975).

General rules of computing amplitudes in the limit of infinite target mass are derived. While reproducing the usual rules of external potential in the case of q.e.d., the rules for gauge theories are more complicated in that the limiting vertices can either depend on the spin variables of the targets, or they can transfer energy. Simple applications of these rules are made to compute vector-boson-fermion scattering amplitude in the limit the masses of fermions go to infinity. (auth)

**13868** GLOBAL SCALE TRANSFORMATIONS FOR RENORMALIZED FIELD OPERATORS. Lukierski, J.; Ogielski, A. T. (Wroclaw Univ. (Poland). Instytut Fyziki Teoretycznej). Phys. Lett., B; 58: No. 1, 57-60(18 Aug 1975).

The modification of canonical scale transformations is considered for renormalized field operators due to the presence of infinite renormalization constants. The renormalization procedure is discussed for the class of Lagrangians which are formally invariant under canonical scale transformations. The consistency with renormalized scaling Ward identities (Callan-Symanzik equations) is achieved. (NL)

**13869** SPONTANEOUS SUPERSYMMETRY BREAKING WITHOUT GAUGE INVARIANCE. Fayet, P. (Ecole Normale Superieure, 75-Paris (France). Lab. de Physique). Phys. Lett., B; 58: No. 1, 67-70(18 Aug 1975).

A model of interacting scalar multiplets is presented where supersymmetry is spontaneously broken, generating a Goldstone spinor. Besides ordinary Goldstone bosons there exist scalar particles, massless at zeroth order. (NL)

**13870** PION DECAYS IN CHIRAL QUANTUM FIELD THEORY. Pervushin, V. N.; Volkov, M. K. (Joint Inst. for Nuclear Research, Dubna (USSR)). Phys. Lett., B; 58: No. 1, 74-78(18 Aug 1975).

Within the framework of the chiral quantum field theory the amplitudes have been calculated for all main pion decays: $\pi^+ \to \mu^+(e^+)\nu$; $\pi^0 \to \gamma\gamma$; $\pi^+ \to \mu^+(e^+)\nu\gamma$; $\pi^+ \to \pi^0 e^+\nu$. (NL)

**13871** ASYMPTOTIC BEHAVIOUR OF TOTAL CROSS SECTION IN THE REGGEON FIELD THEORY. Czechowski, A. (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej). Phys. Lett., B; 58: No. 1, 83-85(18 Aug 1975).

A suggestion is given, based on earlier results of Bronzan and Cardy, that the Reggeon field theory predicts total cross section increasing like $(\log s)^2$ or falling as a power of s (depending on the value of the bare intercept) and that the renormalization group solutions are asymptotically valid only in the unphysical case when the bare intercept takes exactly the "critical" value. (NL)

**13872** AUXILIARY-MASS FORMULATION OF THE PURE YANG-MILLS MODEL. Lowenstein, J. H. (New York Univ., N. Y. (USA). Dept. of Physics). Nucl. Phys., B; 96: No. 2, 189-208(22 Sep 1975).

The massless Yang-Mills model is formulated within the BPHZ framework. Normal products are introduced which satisfy normalization conditions at both vanishing and non-vanishing mass values. The Slavnov identity is derived using the convenient properties of these normal products. Slavnov invariant integrated normal products are constructed and used to derive the Callan-Symanzik (renormalization group) equation corresponding to scaling of the auxiliary mass parameter used to normalize the Green functions. (NL)

**13873** DYNAMICS OF VACUUM EXCITATIONS AND QUARK CONFINEMENT IN QUANTUM FIELD THEORIES. Ezawa, Z.F.; Tze, H. C. (Cambridge Univ. (UK). Dept. of Applied Mathematics and Theoretical Physics). Nucl. Phys., B; 96: No. 2, 264-284(22 Sep 1975).

A unified approach to interacting vacuum excitations and quark confinement is formulated in quantum field theories with symmetry breakdown. Vacuum excitations are shown to be coherent clouds of Goldstone bosons or gauge bosons and are interpreted as new asymptotic extended particle states. They correspond to all dynamically possible space-time dependent Bose condensations of the Goldstone bosons in a given theory. Different configurations of vacuum excitations are connected to one another by a family of invariant boson transformations. As an example, the Nambu theory of interacting vortex strings is derived from a Nambu-Heisenberg quark-gluon field theory. The quarks can be completely confined to the strings while the gluons cluster in quantized magnetic flux bundles of penetration width $m_v^{-1}$ and provide a short range interaction force. (NL)

**13874** ELECTROMAGNETIC FIELDS WITH SYMMETRY. Combe, P. (Aix-Marseille-2 Univ., 13-Marseille (France). Centre Universitaire de Luminy); Sorba, P. (Centre National de la Recherche Scientifique, 13-Marseille (France). Centre de Physique Theorique). Physica; 80: No. 3, 271-286(1975).

A study of the connected subgroups of the Poincare group which can be seen as invariance groups of electromagnetic fields (they will be called CEPS) and of their corresponding invariant fields is reported. It appears that the dimensions of such symmetry groups are less than or equal to six. A method of determination of fields invariant under a Poincare subgroup is proposed and applied to the characterization of all the electromagnetic fields invariant under each six- and five-dimensional CEPS. Moreover, it can be shown that each connected Poincare subgroup of dimension less than or equal to four is either a CEPS or a subgroup of a CEPS. (NL)

**13875** GENERALIZATIONS OF THE WICK-HORI THEOREM. Bui-Duy, Q.; Gonzalez, J. J. Ark. Fys. Semin. Trondheim; No. 10, 9(1975).

The Wick theorem is of great importance in expressing S-matrix elements in terms of one-particle Green's functions, i.e. Feynman graphs. Moreover, its functional formulation due to Hori (the Wick-Hori theorem) opens up computational possibilities in unperturbative quantum field theory. Generalizations of the Wick-Hori theorem are derived and discussed. (JIW)

**13876** MULTIPARTICLE PRODUCTION IN REGGEON FIELD THEORY. Bartels, J.; Rabinovici, E. (Fermi National Accelerator Lab., Batavia, Ill. (USA)). Phys. Lett., B; 58: No. 2, 171-176 (1 Sep 1975).

In the framework of reggeon field theory it is shown that multiparticle production processes with repeated Pomeron exchange satisfy unitarity constraints and avoid decoupling problems, for a small enough PPP coupling. For a large PPP coupling, the existence of a two-Pomeron bound state at j greater than 1 is discussed. It is also found that the leading contribution to sigma/sub ns/ behaves like sigma/sub els/. (NL)

## Gravitation and General Relativity

*Refer also to abstracts 13264, 13273, 13814, and 13855.*

**13877** (AIAU-74203) GEOMETRIC FACTORS IN PROBLEMS OF FIELD PHYSICS. Prochazka, W.; Bensch, F. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Dec 1974. 110p. (In German). INIS.

Copies available from the authors.

The geometric factors in problems of field physics (radiation fields and also gravitational fields and electromagnetic fields) are investigated for finite arrangements. Although in theoretical

considerations field source and probe (test object) are usually assumed to be point-like, realistic measuring arrangements do not justify this assumption. In many cases the assumption is justified that the deviation of the properties of the "real" from the idealized arrangement is caused solely by geometric factors. Based on this assumption one derives and discusses correction formulae for finite sizes of several geometric arrangements. The proposed correction formulae result from second order approximations and are quite accurate. The correction problem of field sources and probes not idealized as points and located arbitrarily is investigated for the first time. The examples of application are taken mainly from neutron physics (for example activation detectors), from radiation physics (for example the calculation of effective solid angles) and from electrostatics. Two main problems are considered: Firstly, for a source and/or a probe of general shape one derives the expected measured quantity from the known field distribution of point-like sources. Secondly, one relates measured quantities to values obtained from fields of point-like sources and probes. Furthermore, one demonstrates that the proposed correction formulae are closely related to an expansion of the corresponding functions in "generalized" static multipoles. The investigation of the asymptotic behavior of the measurable quantities for distances between source and probe converging to infinity reveals unexpected results in certain cases. (auth)

**13878** (INIS-mf-1804) RELATIVISTIC THEORY OF SOUND PROPAGATION. Guichelaar, J. (Amsterdam Univ. (Netherlands)). 1974. 73p. INIS.

See Physica 59(1972)97, Physica 68(1973)342, Physica 74(1974) 330, Physica 75(1974)593.

The aim of this thesis is to develop the theory of sound propagation in gases within the framework of special relativity. Results of the relativistic theory of sound play a role in astrophysical "big bang" theories. Just after the "big bang" temperatures are very high and large numbers of neutrinos and photons are present. These very conditions require a relativistic description. The properties of sound waves, e.g. the speed of propagation and the damping coefficient, are derived on two levels. Firstly the macroscopic level, where one starts from the covariant hydrodynamic equations for the gas. Secondly the microscopic level, where one starts from the relativistic extension of Boltzmann's kinetic equation. Both methods are applied to a single-component system as well as to a mixture of an arbitrary number of components. The results of the two methods are shown to be in agreement. For a model, specified by the particle cross-section, the results are considered in particular. (auth)

**13879** CRYSTAL STRUCTURES, THE EARTH AND DIRAC'S LARGE NUMBERS HYPOTHESIS. Towe, K. M. (Smithsonian Institution, Washington, DC). Nature (London); 257: No. 5522, 115-116(11 Sep 1975).

Dirac's large numbers hypothesis assumes that the large dimensionless numbers obtained from the ratios between fundamental physical constants are related to the age, t, of the universe. The theory requires that matter be continuously created with time and that the gravitational constant, G, varies with time. In order to reconcile these requirements with Einstein's theory of gravitation two metrics are required. The first, referred to as the Einstein metric, involves the equations of motion and classical mechanics, and the second, referred to as the atomic metrix, involves quantum mechanics and laboratory measurements of distances and time, as determined by atomic apparatus. The continuous creation of mass requires either of two models- the first, termed additive creation, assumes that matter is created uniformly throughout space, whilst the second requires the creation of matter where matter already exists in proportion to the amount and kind already existing, and is known as multiplicative creation. Suggested tests of the theory remain unconfirmed. Measurements of astronomical distances with atomic apparatus could provide a test, as could highly accurate secular measurements of G. The earth could also provide tests for the theory. Rock crystals of the earth give a record of possible changes from at least $3 \times 10^8$ years ago, and their atomic structures should agree with predictions of the theory. Geological evidence, however, does not confirm the predictions of the theory, and in its present form the large numbers hypothesis seems to be unacceptable. (UK)

**13880** SPINOR FORMALISM AND COMPLEX-VECTOR FORMALISM OF GENERAL RELATIVITY. Han-ying, G.; Yong-shi, W.; Gendao, L. Chin. J. Phys. (Peking) (Engl. Transl.); 23: No. 5, 187-193(Sep 1974).

In this paper, using E. Cartan's exterior calculus, we give the spinor form of the structure equations, which leads naturally to the Newman–Penrose equations. Furthermore, starting from the spinor spaces and the SL(2C) algebra, we construct the general complex-vector formalism of general relativity. We find that both the Cahen–Debever–Defrise complex-vector formalism and that of Brans are its special cases. Thus, the spinor formalism and the complex-vector formalism of general relativity are unified on the basis of the unimodular group SL(2C) and its Lie algebra. (auth)

**13881** QUANTUM THEORY AND THE STRUCTURES OF TIME AND SPACE. Conference Held at Feldafing, Germany, July 1974. Castell, L.; Drieschner, M.; von Weizsacker, C. F. (eds.). Munich; Carl Hanser Verlag (1975). 252p. (CONF-740762-).

Separate abstracts were prepared for the 12 papers presented. (JFP)

*For abstracts of individual papers see: 12860–12862, 13214–13216, 13415, 13816–13818, 13849, and 13882.*

**13882** COMPLEX SPACE-TIME AND SOME CURIOUS CONSEQUENCES. Newman, E. T. (Univ. of Pittsburgh). pp 117-127 of Quantum Theory and the Structures of Time and Space. Castell, L. (ed.). Munich; Carl Hanser Verlag (1975).

From conference on quantum theory and structures of time and space; Feldafing, F. R. Germany (Jul 1974). See CONF-740762-.

The discussion of space-time and its consequences includes only the classical theory of mechanics, electricity and magnetism, and the Einstein theory of gravitation. It is pointed out that one can interpret many familiar ideas from these theories in a unified way if one allows physical space-time (either Minkowski space or the curved space-time of the Einstein theory) to be analytically extended. (JFP)

**13883** WEYL-LIKE EQUATION FOR THE GRAVITATIONAL FIELD. Doria, F. A. (Univ. Federal, Rio de Janeiro). Lett. Nuovo Cim.; 14: No. 13, 480-482(29 Nov 1975).

It is shown that the full gravitational equations can be written in neutrino-like fashion. (JFP)

**13884** GRAVITATIONAL WAVES ON ELASTIC MEDIUM. Souriau, J. M. (Aix-Marseille-1 Univ., 13–Marseille (France)). pp 243-256 of Ondes et Radiations Gravitationnelles. Paris; Centre National de la Recherche Scientifique (1974). (In French)

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The aim of this work is to find out to what extent the action of a gravitational wave on an elastic body can be treated exactly. The idea is not so much to calculate what happens under certain fairly ideal circumstances but to be able to check by comparison, the various methods of approximation which may have to be used. (FR)

**13885** SOME REMARKS ON THE CONSERVATION LAWS. Papapetrou, A. (Paris-6 Univ., 75 (France). Inst. Henri Poincare). pp 235-241 of Ondes et Radiations Gravitationnelles. Paris; Centre National de la Recherche Scientifique (1974). (In French)

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The conservation laws in generalized relativity are examined for gravitational fields of Minkowsky-asymptotic behavior. (FR)

**13886** GRAVITATIONAL SHOCK WAVES AND ELECTROMAGNETIC WAVES. Lichnerowicz, A. (College de France, 75 - Paris). pp 47-56 of Ondes et Radiations Gravitationnelles. Paris; Centre National de la Recherche Scientifique (1974). (In French)

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

A method based on the distribution technique is presented. The connections between gravitational shock waves and electromagnetic shock waves are also studied. (FR)

**13887** COVARIANT DECOMPOSITIONS OF SYMMETRIC TENSORS IN THE THEORY OF GRAVITATION. York, J. W. Jr. (North Carolina Univ., Chapel Hill (USA)). Ann. Inst. Henri Poincare, Sect. A; 21: No. 4, 319-332(1974).

Covariant orthogonal decompositions of symmetric tensors have proven to be of great interest in the theory of gravitation and in characterizing spaces of Riemannian metrics. The known transverse decomposition t and a transverse-traceless decomposition TT introduced recently are described and compared. The consistency and compatibility of these two procedures are demonstrated by showing that if $T^{ab}$ is an arbitrary symmetric tensor, then $T^{ab}_{TT} = (T^{ab}_{tT}) = (T^{ab}_{Tt})_t$. The relationships of the various remaining longitudinal and trace parts of $T^{ab}$ are exhibited. It is found that every transverse tensor can be uniquely and orthogonally decomposed into a sum of a transverse-traceless part and another part that is transverse but has in general a nonvanishing trace. Physical interpretation of the reaction between transverse

and transverse-traceless tensors is provided by the canonical momentum of a gravitational field. Geometrical interpretation follows from considering the structure of the space of conformal metrics on closed manifolds. (FR)

**13888** ON PLANE WAVE SOLUTIONS OF THE FIELD EQUATIONS OF GENERAL RELATIVITY. Najaf, A. (M.L.K. Coll., Balrampur (India). Dept. of Mathematics). Indian J. Pure Appl. Math.; 4: No. 7, 664-669(Jul 1973).

A generalization of the plane wave solutions of the field equations of general relativity has been attempted by assuming the space-time metric with all its components as functions of a single variable Z(z,t). This approach has the advantage that the general solutions so obtained reduce to different types of plane wave solutions under restricted conditions. (auth)

**13889** EINSTEIN–CARTAN THEORY OF GRAVITATION. Trautman, A. (Warsaw Univ. (Poland). Instytut Fizyki Teoretycznej). pp 161-170 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

In 1923 E. Cartan proposed a modification of Einstein's general theory of relativity in which it is assumed as a model of the universe, a differentiable variety equipped with a metric tensor and an asymmetrical Euclidian linear connection. The twist of this correction is directly related to the spin density. Some recent results obtained in the context of the Einstein - Cartan theory are given. (FR)

**13890** RADIATING KERR–SCHILD METRIC. Vaidya, P. C. (Gujarat Univ., Ahmedabad (India). Dept. of Mathematics). pp 379-381 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The most general solution of field equations is obtained for a metric of the form $g_{ik} = \eta_{ik} + H\,\xi_i\,\xi_k$. The general properties of an isotropic congruence $\xi_i$ without distortion in the Mikowski space is discussed. Two angular coordinates $\alpha$ and $\beta$ and an isotropic coordinate $\mu$, which are later used to describe the metric, are defined in particular. (FR)

**13891** ELECTRODYNAMICS, GRAVITATION, AND SPIN. Israel, W. (Alberta Univ., Edmonton (Canada). Theoretical Physics Inst.; Alberta Univ., Edmonton (Canada). Dept. of Physics). pp 301-308 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

A kinetic model is used to show how the Einstein and Maxwell field equations must be modified in the presence of a medium where the particles have internal spin. The resulting equations form an extension into general relativity of Lorentz's dielectric theory. (FR)

**13892** RADIATION FROM HIGHLY RELATIVISTIC GEODESICS. Misner, C. W. (Oxford Univ. (UK). Dept. of Astrophysics). pp 145-160 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

A number of recent studies carried out mainly at the University of Maryland on the generation and emission of gravitational waves are reviewed. One essential conclusion is that in the high frequency range the generation of gravitational radiation is a local phenomenon. Two examples are given to illustrate this generation when a high-energy particle hits the space time curvature. One, due to Matzner and Nutku, uses a virtual photon method, the other due to Chrzanowski and the author, is based on the W.K.B. approximation, corresponding to geometrical optics, for the non-homogeneous wave equation - the basic new idea being a factorized integral representation of Green's function - valid at least asymptotically towards infinity in space. (FR)

**13893** TENSOR-VECTOR THEORY OF GRAVITATION. Madore, J. (Paris-6 Univ., 75 (France). Inst. Henri Poincare). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 12, 841-843 (24 Mar 1975). (In French)

A theory of gravitation is proposed which exhibits the property of saturation of the gravitational forces at small distances. (FR)

**13894** VARIATIONAL METHODS AND GRAVITATIONAL WAVES. Taub, A. H. (California Univ., Berkeley (USA)). pp 57-71 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The results obtained by applying to Einstein's equations the Whitham technique in the two-timing approximation scheme, using an averaged Lagrangian, are reviewed. This application to the problem of high-frequency gravitational waves differs somewhat from that given by McCallum and Taub and can be used to discuss the problems which arise when the non-perturbed (basic) metric is not assumed slowly variable. Such a problem appears on examination of the interaction between a high-frequency perturbation and an exact solution of Einstein's equations corresponding to a generalization of a weak plane gravitational wave propagating along a given direction. (FR)

**13895** CLASSICAL GENERAL RELATIVITY: A CONSEQUENCE OF QUANTUM THEORY. Deser, S. (Brandeis Univ., Waltham, Mass. (USA). Dept. of Physics). pp 135-143 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

From the fundamental axiom of quantum mechanics in the restricted relativity, that any interaction is due to the exchange of particles, are inferred: 1) the existence and properties of the self-interaction for gravitons; 2) the existence of a classical limit to this quantum system at low enough frequencies; 3) the fact that this limit is only described by Einstein's equations. (FR)

**13896** RELATIVISTIC VERSION OF THE CHAPMAN–ENSKOG METHOD. Marle, C. M. (Besancon Univ., 25 (France)). pp 313-330 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974). (In French)

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

A relativistic version of the Chapman-Enskog method is formulated as comprehensively as possible. It is presented systematically, especially for approximations of order higher than one. It is coherent in its principle and respects relativistic covariance. (FR)

**13897** CAUSAL TRANSPORT LAWS IN RELATIVISTIC THERMODYNAMICS. Stewart, J. (Max-Planck-Institut fuer Physik und Astrophysik, Muenchen (F.R. Germany)). pp 339-342 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The usual phenomenological transfer laws in relativistic thermodynamics, deducible from relativistic kinetic theory, are known to transgress the laws of causality. The underlying hypotheses are examined here and the transport equations, more complicated but causal, are deduced. (FR)

**13898** MEUDON GRAVITATIONAL RADIATION DETECTION EXPERIMENT. Bonazzola, S.; Chevreton, M.; Felenbok, P.; Herpe, G.; Thierry-Mieg, J. (Observatoire de Paris, Section de Meudon, 92 (France)). pp 101-111 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974).

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

The Weber type gravitational wave detector built at the Meudon observatory is described. The results of double and triple coincidence research with the Munich and Frascati detectors are given. The possibility of increasing the sensitivity of an uncooled detector using a method of passive detection by capacitance is investigated. (auth)

**13899** ASYMPTOTIC WAVES IN RELATIVISTIC ELASTIC MEDIA. Lamoureux, L. (Paris-6 Univ., 75 (France)). pp 343-346 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974). (In French)

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

Since 1959 several authors have proposed constitutive laws for relativistic media, i.e. laws relating the stress tensor to the speed vector or the deformation tensor. There the law proposed by Synge will be used: the stress rate tensor is a linear function of the deformation rate tensor. This is the generalization of Hooke's law used in classical mechanics for hypoelastic media. (FR)

**13900** GRAVITATIONAL AND ELECTROMAGNETIC WAVE COUPLING AT HIGH FREQUENCY. Choquet-Bruhat, Y. (Paris-6 Univ., 75 (France)). pp 85-100 of Ondes et Radiations Gravitationnelles. Paris, France; Centre National de la Recherche Scientifique (1974). (In French)

From international colloquium on gravitational waves and radiations; Paris, France (18 Jun 1973).

Further details are given on the subject of an earlier work entitled Approximate Radiative Solutions of Einstein-Maxwell Equations. The method is derived from the W.K.B. method. The necessary and adequate conditions are obtained for the gravitational and electromagnetic fields to be an asymptotic solution of the Einstein-Maxwell system at each order of approximation, without averaging over a space-time region. The asymptotic validity at zero order gives the algebraic conditions on the gravitational and electromagnetic waves, the validity at the next order gives both the propagation equations for the significant part of these waves and also supplementary conditions. These depend on the respective orders of magnitude of the two parameters defining on the one hand the amount of perturbation with respect to the basic field, on the other the oscillation with respect to the amplitude variations. Two cases are examined. (FR)

**13901** RESPONSE OF RIGID ROTATORS TO GRAVITATIONAL RADIATION. Dautcourt, G. (Akademie der Wissenschaften der DDR, Potsdam. Zentralinstitut fuer Astrophysik). Astron. Nachr.; 296: No. 1, 25-29(1975).

The response of an axially symmetric rigid rotator to incident gravitational radiation is discussed for particular states of free rotator motion using generalized EULERian equations, and assuming wavelengths large compared with the rotator dimensions. First, if coincident initially, the rotation and the symmetry axes slightly differ after exposure to a radiation flux which has suitable polarization and propagates perpendicular to the rotation axis. Secondly, the angular velocity of a rotation perpendicular to the symmetry axis is changed in a wave field propagating in the direction of the rotation axis (BRAGINSKI-rotator). (auth)

**13902** GRAVITATIONAL ATTENUATION AND THE INTERNAL HEATING OF PLANETARY BODIES. Crowley, R. J.; Woodward, J. F. (California State Univ., Fullerton (USA)); Yourgrau, W. (Denver Univ., Colo. (USA)). Astron. Nachr.; 295: No. 5, 203-206(1974).

The hypothesis of gravitational attenuation is discussed and several theoretical problems with possible solutions are noted. It is pointed out that, if energy were attenuated out of the gravitational field by matter, it would ultimately be thermalized. Geothermal data are then employed to establish an upper limit to the gravitational attenuation coefficient, some fifteen orders of magnitude smaller than the currently accepted value. The internal heating of other planetary bodies is investigated to see if a yet smaller upper limit is deducible therefrom—with negative results.

**13903** EXTERIOR FIELD OF A CHARGED PARTICLE. Rao, J. R.; Karade, T. M. (Indian Inst. of Technology, Kharagpur). Acta Phys. Acad. Sci. Hung.; 38: No. 3, 221-223(1975).

Various metrics characterizing the exterior space-time of a charged particle are developed by introducing a gravitational potential in place of the curvature coordinate r occurring in the Reissner–Nordstrom solution. (auth)

**13904** A RELIABLE EXPERIMENT FOR THE PROOF OF THE SPACE-TIME ABSOLUTENESS. Marinov, S. Phys. Lett., A; 54: No. 1, 19-20(11 Aug 1975).

A realizable modification of the historical Harress experiment is proposed which shows that the velocity of light is direction dependent in any frame moving with respect to absolute space. (auth)

**13905** RADIATION DAMPING OF THE ELECTRON IN A GRAVITATIONAL FIELD. Barut, A. O. (Univ., Munich); Villarroel, D. J. Phys., A (London); 8: No. 10, 1537-1542(Oct 1975).

The radiation damping terms in the equation of motion of an electron in a curved space are deduced by the method of analytic continuation. This method works in curved space with essentially the same simplicity as in the flat space case. The contrast between the laborious usual procedure and the simplicity of the present one is remarkable. (auth)

**13906** ASYMPTOTIC RADIATION AND MOTION OF CLASSICAL CHARGED PARTICLES. Wiebe, H. D. Norman, OK; Univ. of Oklahoma (1974). 84p. University Microfilms Order No. 75-6565.

Thesis (Ph. D.).

The relativistic behavior of classical charged particles with constant spin was studied. The asymptotic radiation rates of linear and angular momentum from such a particle were calculated. The results of these calculations were then used in derivations of equations of linear and angular motion. The calculation of the asymptotic radiation rate of angular momentum was done with an arbitrary coordinate origin. It is shown that the result of this calculation must be dependent on the choice of origin. The result also shows that angular momentum can be radiated asymptotically even by a nonspinning charge. The equations of motion are derived by a method which, in the case of linear motion of a nonspinning charge, produces the Dirac equation of motion for such a charge but avoids some of the difficulties, such as infinite renormalization, connected with the method used by Dirac. (Diss. Abstr. Int., B)

**13907** EXACT RESULTS ON THE STRUCTURE OF MATTER. Thirring, W. (Univ., Vienna). pp 3-23 of Laws of Hadronic Matters. Zichichi, A. (ed.). London; Academic Press Inc. (1975).

From international school of subnuclear physics; Erice, Trapani, Sicily, Italy (8 Jul 1973). See CONF-730755–.

For the treatment of exact results on the structure of matter, a system of N nonrelativistic particles interacting with Coulomb and Newton potentials governed by a given Hamiltonian is considered. Only the exact bounds are quoted, and the results of uncontrolled approximations are considered as irrelevant. The method of minimal concavity and cosmic bodies are treated. (JFP)

# REACTOR TECHNOLOGY AND REGULATION

**13908** (JAERI-M-5959) DESIGN DATA AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS IN JAPAN. Morishima, A.; Fujita, M.; Kuriyama, M. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 118p. (In Japanese). INIS.

The design data and safety features of twenty commercial nuclear power plants in Japan are presented for about 400 items. The lists of reactors, items, abbreviations and key words as well as the KWOC index are also given. (auth)

**13909** (JAERI-M-5968) DESIGN AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS IN THE UNITED STATES. General Description. Kuriyama, M.; Morishima, A. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 27p. (In Japanese). INIS.

General descriptions of commercial nuclear power plants in the United States are given for 85 PWRs and 52 BWRs. Covered are the names of reactor and plant, and the manufactures of pressure vessel, containment vessel and steam system. Docket number index and alphabetical plant index are also given. (auth)

**13910** (JAERI-M-5995) DESIGN AND SAFETY FEATURES OF COMMERCIAL NUCLEAR POWER PLANTS IN THE UNITED STATES. Nuclear Characteristics. Kuriyama, M.; Morishima, A. (Japan Atomic Energy Research Inst., Tokyo). Feb 1975. 35p. (In Japanese). INIS.

Nuclear characteristics of commercial nuclear power plants in the United States are given for 85 PWRs and 52 BWRs. Covered are burnup, enrichment, rod worth, some coefficients of moderator, type of burnable poison and others. Definitions of some items are also given. (auth)

**13911** (JUL-1232) THERMODYNAMIC CALCULATION OF A LONG-DISTANCE ENERGY CIRCUIT. Hoehlein, B.; Bauer, A.; Kraut, G.; Scherberich, F. D. (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany). Inst. fuer Reaktorbauelemente). Aug 1975. 33p. (In German). Dep. NTIS (US Sales Only) $5.00.

A calculational model is presented for the nuclear long distance energy circuit. Such a circuit means the combination of a steam reforming plant with heat supply from a high temperature nuclear reactor and a methanation plant with heat production for district heating or electricity production. The model comprises thermodynamic calculations for the endothermic methane reforming reaction as well as the exothermic CO-hydrogenation in adiabatic reactors and allows the optimization of the long distance energy circuit under consideration. (auth)

**13912** (LA-6113-MS) PREDICTED NUCLEAR HEATING AND TEMPERATURES IN GAS-COOLED NUCLEAR REACTORS FOR PROCESS HEAT APPLICATIONS. Cort, G. E.; Vigil, J. C.; Jiacoletti, R. J. (Los Alamos Scientific Lab., N. Mex. (USA)). Sep 1975. Contract W-7405-ENG-36. 27p. Dep. NTIS $4.00.

The high-temperature gas-cooled nuclear reactor (HTGR) is an attractive potential source of primary energy for many industrial and chemical process applications. Significant modification of current HTGR core design will be required to achieve the required elevations in exit gas temperatures without exceeding the maximum allowable temperature limits for the fuel material. A preliminary evaluation of the effects of various proposed design modifications by predicting the resulting fuel and gas temperatures with computer calculational modeling techniques is reported. The design modifications evaluated are generally those proposed by the General Atomic Company (GAC), a manufacturer of HTGRs, and some developed at the LASL. The GAC modifications do result in predicted fuel and exit gas temperatures which meet the proposed design objectives. (auth)

**13913** (NP-20612) ANNUAL REPORT, 1974. Weinhold, S. A. (ed.). (Kernforschungsanlage Juelich G.m.b.H. (F. R. Germany)). 1975. 140p. (In German). Dep. NTIS (US Sales Only) $10.00.

The 1974 annual report from Kernforschungsanlage Juelich is divided into the following sections: selections from research work; report on research and development; research institute and joint scientific-technical arrangements; and organization, administration, and technical infrastructure. (RWR)

**13914** (ORNL-TM-5070(Rev.)) IMPACT OF INCREASED FUEL COSTS AND INFLATION ON THE COST OF DESALTING SEAWATER AND BRACKISH WATERS. Reed, S. A. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 22p. Dep. NTIS $5.00.

The combined increases in the cost of fuel, equipment, and money during the past four years have had a marked impact on the cost of desalting saline waters. The current costs of desalting seawater by distillation and reverse osmosis and brackish waters by reverse osmosis and electrodialysis as a function of plant size and feedwater chemistry are estimated. Typically, distillation plant capital costs have increased from $1 per daily gallon to $3 per daily gallon for large plants (100 Mgd) and from approximately $1.40 per daily gallon to approximately $5 per daily gallon per plant sizes of 5 Mgd or less. Consequently, water costs are now ranging from $3 to $4 per 1000 gal when oil is used to generate steam. Similarly, the costs of desalting inland brackish waters using reverse osmosis or electrodialysis have increased significantly. (auth)

**13915** DISTRICT AND INDUSTRIAL HEATING BY ATOMIC POWER STATIONS. Leclere, G. Sci. Avenir; No. 339, 434-438(May 1975). (In French)

The various solutions envisaged to design nuclear power plants intended for a total power production (heat + electricity) are examined. The performance of the various reactor types as process heat reactors are discussed. (FR)

**13916** SYSTEMS OF DISTRICT HEATING UTILIZING ATOMIC HEAT SOURCES. Sukhov, A. B.; Kovylyanskii, Ya. K.; Gurevich, I. V. Elektr. Stn.; No. 9, 37-41(Sep 1974). (In Russian).

Comparison of various types of reactor shows that the gas-cooled, graphite-moderated system satisfies all the requirements of district-heating, being the most economic. However, as this type of reactor is not produced in the USSR, the authors recommend that a pressurized boiling-water type be used. A novel method of selecting the best type of district-heating system is suggested, which takes the system as a whole into account: the heat source (running on any form of fuel), the thermal network and the consumer's installation. An analysis of various systems, carried out on a digital computer, suggests that a nuclear district-heating system tailored to the conditions existing in the European USSR could and should be built, starting with thermal loads of 1000 Gcal/hr and above. These would take the form of nuclear boiler stations from 1000 to 1500 Gcal/hr and nuclear power stations above 1500 Gcal/hr. (Electr. Electron Abstr.)

## Power Reactors, Non-Breeding, BWR-Type

*Refer also to abstracts 12581, 12652, 14063, 14073, 14077, 14078, 14108, 14123, 14124, 14129, 14132, 14140, 14141, 14190, 14198, and 14209.*

**13917** (BNWL-1898) GAPCON-THERMAL-2: A COMPUTER PROGRAM FOR CALCULATING THE THERMAL BEHAVIOR OF AN OXIDE FUEL ROD. Beyer, C. E.; Hann, C. R.; Lanning, D. D.; Panisko, F. E.; Parchen, L. J. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. 195p. Dep. NTIS $8.50.

A description is presented of the computer code GAPCON-THERMAL-2, a light water reactor (LWR) fuel thermal performance prediction code. GAPCON-THERMAL-2 is intended to be used as a calculational tool for reactor fuel steady-state thermal performance and to provide input for accident analyses. Some models used in the code provide best estimate as well as conservative predictions. Each of the individual models in the code is based on the best available data. (auth)

**13918** (BNWL-SA-5548) ROLE OF IN-SERVICE INSPECTION ON THE RELIABILITY OF PRIMARY SYSTEM PIPING. Bush, S. H.; Ham, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract W(45-1)-1830. 11p. (CONF-751044-2). Dep. NTIS $4.50.

From ANS topical meeting on nuclear safety; Tucson, Arizona, USA (5 Oct 1975).

The reliability of the primary piping is assessed on the basis of historical data, the role of periodic surface and volumetric inspection in decreasing the probability of a major failure, the validity of the requirements for inspection imposed by ASME Section XI and by NRC Regulatory Guides and the reliability and sensitivity of the various inspection techniques. (auth)

**13919** (CONF-750827--, pp 71-82) TECHNOLOGY FOR DISMANTLING LARGE RADIOACTIVE STRUCTURAL COMPONENTS. Blumberg, R. (Holifield National Lab., Oak Ridge, TN). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The dismantling of the ERR (Elk River Reactor) was completed successfully and safely in September, 1974. This 58 MW(t), boiling water reactor was removed down to its foundations, and all of the radioactive material was shipped in suitable containers to licensed burial grounds. The most difficult and the unique part of this effort was the cutting up and removal of the radioactive structural parts, namely the inner thermal shield, the pressure vessel, and the outer thermal shield. The tools and techniques for this operation were designed, developed, and fabricated at the Oak Ridge National Laboratory. This development provides the nuclear industry with a viable alternative to entombment and surveillance for decommissioning reactors. The technology used is described, and comments are made on its application to larger, more radioactive systems. (auth)

**13920** (CONF-750977-, pp 16.1-16.12) PARAMETER IDENTIFICATION IN THE BWR. Rao, H. S. (Systems Control, Inc., Palo Alto, CA); Frogner, B.; Gupta, N. K.; Carmichael, L. A. 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

An approach used for parameter identification in a boiling water reactor is discussed. An algorithm based on a maximum likelihood formulation using an extended Kalman filter as a state estimator has been developed. The model to be identified is a sixteenth order lumped model of the neutronic feedback effects in the reactor core. Pressure perturbations are utilized to initiate transients suitable for parameter identification. Estimation of the control rod reactivity during scram conditions is also investigated. (auth)

**13921** (CONF-751132-1) HEAVY SECTION STEEL TECHNOLOGY PROGRAM, Part I. Program Scope, Fracture, Materials and Thermal Shock Studies. Whitman, G. D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 36p. Dep. NTIS $5.00.

From Japan Industrial Planning Association symposium; Tokyo, Japan (17 Nov 1975).

A brief summary of the scope of HSST projects is presented. A major emphasis throughout the course of this work is the verification of methods of fracture prediction which can be utilized in an assessment of pressure vessel integrity. The utility of small specimens which are appropriate for surveillance purposes, continues to be investigated in both the unirradiated and post-irradiated conditions. 11 references (auth)

**13922** (CONF-751132-2) HEAVY SECTION STEEL TECHNOLOGY PROGRAM, Part II. Intermediate Vessel Testing. Whitman, G. D. (Oak Ridge National Lab., Tenn. (USA)). 1975. 32p. Dep. NTIS $4.50.

From Japan Industrial Planning Association symposium; Tokyo, Japan (17 Nov 1975).

The testing of the intermediate pressure vessels is a major activity under the Heavy Section Steel Technology Program. A primary objective of these tests is to develop or verify methods of fracture prediction, through the testing of selected structures and materials, in order that a valid basis can be established for evaluating the serviceability and safety of light-water reactor pressure vessels. These vessel tests were planned with sufficiently specific objectives that substantial quantitative weight could be given to the results. Each set of testing conditions was chosen so as to provide specific data by which analytical methods of predicting flaw growth, and in some cases crack arrest, could be evaluated. Every practical effort was made to assure that results would be relevant to some aspect of real reactor pressure vessel performance, through careful control of material properties, selection of test temperatures, and design of prepared flaws. 5 references. (auth)

**13923** (EIR-281) ATMOSPHERIC COOLING OF NUCLEAR POWER PLANTS: COMPARISON BETWEEN DRY AND WET COOLING. Mayor, J. C. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). Nov 1975. 11p. (CONF-750411-85). Dep. NTIS (US Sales Only) $4.50.

From European nuclear conference; Paris, France (21 Apr 1975).

Technical and economic considerations are compared for dry versus wet cooling tower utilization at light water reactor plants in the 900 MW(e) range. (DG)

**13924** (ORNL-TM-5090) EVALUATION OF THE HSST PROGRAM INTERMEDIATE PRESSURE VESSEL TESTS IN TERMS OF LIGHT-WATER-REACTOR PRESSURE VESSEL SAFETY. Merkle, J. G.; Whitman, G. D.; Bryan, R. H. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 49p. Dep. NTIS $5.45.

Eight 6-in.-thick 39-in.-OD steel pressure vessels containing carefully prepared and sharpened surface cracks have been tested to provide an improved quantitative basis for evaluating the safety margins against fracture of nuclear reactor pressure vessels. The cylindrical regions of the test vessels were fabricated from either A508 class 2 forging steel or A533, grade B, class 1 steel plate. All the eight vessels tested were loaded to failure by internal hydraulic pressure. Flaws in the test vessels ranged from 1.20 to 5.30 in. in depth, and test temperatures ranged from 32 to 196$^0$F. Extensive fast fracture was observed, as expected, at 32$^0$F at a pressure near the gross yield pressure of the test vessel, and two vessels leaked without fracturing at or slightly above 190$^0$F. One of these vessels contained a flawed nozzle, and the other contained a very deep external surface flaw. Another vessel containing a smaller external surface flaw achieved 2 percent strain in the plastic range at 190$^0$F before developing a shear fracture that arrested before reaching the ends of the vessel. Extensive pre- and posttest fracture analyses have been performed for all the intermediate vessels tested. 11 references. (auth)

**13925** NEPTUNE: A MODULAR SYSTEM FOR LIGHT-WATER REACTOR CALCULATION. Bouchard, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees); Kanevoky, A.; Reuss, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). pp 141-143 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

A complete modular system of light water reactor calculations has been designed. It includes basic nuclear data processing, the APOLLO phase: transport calculations for cells, multicells, fuel assemblies or reactors, the NEPTUNE phase: reactor calculations. A fuel management module, devoted to the automatic determination of the best shuffling strategy is included in NEPTUNE. (FR)

**13926** STRESS CORROSION FAILURE OF STAINLESS STEEL COMPONENTS IN A BWR AND THE EFFECT OF CYCLIC LOADING ON THE CRACK PROPAGATION. Kondo, T.; Ogawa, Y.; Nakajima, H. (Japan Atomic Energy Research Inst., Tokai-mura). pp 346-358 of Corrosion Problems in Energy Conversion and Generation. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974). See CONF-7410138-.

Two types of problems originated from the stress corrosion cracking (SCC) of the stainless steel components are described. In both cases quantitative estimation of crack growth as functions of either time or number of operation cycles became of significant concern for the rest of life. The cracks in the weld overlay of the RPV liner were suspected to work as the stress raisers, when fatigue of the vessel in the corrosive aqueous environment was considered. More typical stress corrosion cracks around the weld joints became an alternative subject of study. A series of laboratory experiments on the effect of simulated reactor environment on the rate of crack growth under alternated stresses were conducted. 15 references. (auth)

## Power Reactors, Non-Breeding, PWR-Type

*Refer also to abstracts 13917, 13918, 13921–13925, 14063–14067, 14073, 14075–14077, 14124, 14129, 14132, 14139, 14140, 14143, 14198, 14200, and 14205.*

**13927** (BAW-10113) THOR: THERMAL CROSS SECTION GENERATION CODE USING ENDF/B DATA. Andrews, J. B. II; Hassan, N. M.; Wittkopf, W. A. (Babcock and Wilcox Co., Lynchburg, VA (USA)). Dec 1975. 93p. Babcock and Wilcox, Lynchburg, VA.

THOR processes ENDF/B data files to produce a master thermal library containing multigroup cross sections, scattering kernels, and slowing-down source distributions for use in thermal spectrum calculations. The thermal energy range may be described by up to 80 energy groups, and a weighting spectrum may be either input or calculated by the program for use in obtaining average group coefficients. Resonance contributions to the thermal cross sections are added to the appropriate smooth cross sections to

obtain the cross section for each reaction type. Scattering kernels may be produced using either thermal neutron scattering law data or free gas scattering law data, depending on the form of the data present on the ENDF/B data file for the material. Slowing-down source distributions are calculated for each material assuming a 1/E neutron flux in the epithermal energy range. The master thermal library produced by THOR may contain up to 100 materials with coefficient data present at a maximum of 25 temperatures for each material. (auth)

**13928** (BAW-3647-33) PHYSICS VERIFICATION PROGRAM. Part III, Tasks 8–11. Summary Report. Baldwin, M. N.; McAdams, V. D.; Warren, H. D.; Webb, H. W. (Babcock and Wilcox Co., Lynchburg, Va. (USA). Research and Development Div.). Oct 1975. Contract AT(11-1)-3109. vp. Dep. NTIS $5.45.

Summary results are presented for the following PWR experimental tasks: fuel gap detectability study, capture measurements, prompt incore detector study, and 17 by 17 subassembly mockups. (DG)

**13929** (CONF-750977-, pp 14.1-14.5) ANALYSIS OF A MALFUNCTION IN A PRESSURIZED WATER REACTOR. Saxe, R. F. 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

An investigation into the dynamic behavior of the H. B. Robinson Unit 2 PWR revealed an anomaly in the neutron density fluctuations. The methods used to analyze the anomaly are described. It is concluded the fluctuations are caused by primary coolant flow variations. (HDR)

**13930** (CONF-750977-, pp 20.1-20.19) RECENT EXPERIENCES IN DIAGNOSTICS AND INCIPIENT FAILURE DETECTION AT WESTINGHOUSE. Gopal, R. (Westinghouse Electric Corp., Pittsburgh). 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

Over the past several years, Westinghouse has developed several instrument systems for the acquisition and analysis of data for diagnostics and incipient failure detection. Primary motivation for this work is to improve NSSS availability through the detection of malfunctions at their inception. These systems encompass two major areas: (1) Acoustic Monitoring Systems for detection and location of crack propagation and leaks in the primary system pressure boundary of PWRs, and (2) Vibration Monitoring Systems for detection of changes in vibrational characteristics of the major components of Nuclear Steam Supply System (NSSS) and Balance of Plant (BOP). Some of the features of the system and in-plant experience are summarized. (auth)

**13931** (CONF-750977-, pp 25.1-25.11) AXIAL POWER SHAPING IN LARGE PRESSURIZED WATER REACTORS. Jorge, H. M.; Long, R. L.; Purohit, S. N. 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

A one-dimensional geometrical model, coupled with Doppler- and thermal-hydraulics-feedback, was developed for axial power shaping studies in PWRs. As a first step, the power-feedback model was developed for, and tested with, a three-dimensional, quarter-core geometrical model. Next, the power-feedback model was formulated in one-dimensional geometry. The geometry effects on feedback evaluation were assessed. The one-dimensional model was benchmarked against startup test data from the Consolidated Edison Company, Indian Point Unit No. 2 reactor. Load-follow operation, free- and controlled- axial xenon oscillations were simulated and benchmarked against startup test data, for assessing the model accuracy and limitations. The adequacy of the model and its ability for meeting current accuracy requirements were established. (auth)

**13932** (CONF-751101-17) CHARACTERIZATION OF IRRADIATED FUEL RODS USING PULSED EDDY CURRENT TECHNIQUES. Martin, M. R.; Francis, W. C. (Aerojet Nuclear Systems Co., Sacramento, Calif. (USA)). Nov 1975. Contract AT(10-1)-1375. 30p. Dep. NTIS $5.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A number of irradiated fuel rods and unfueled zircaloy cladding tubes ("water tubes") were obtained from the Saxton reactor through arrangements with the Westinghouse Electric Corporation for use in subsequent irradiation effects and fuel behavior programs. A comprehensive nondestructive and corroborative destructive characterization program was undertaken on these fuel rods and tubes by ANC to provide baseline data on their characteristics prior to further testing and for comparison against post-post data. This report deals primarily with one portion of the NDT program performed remotely in the hot cells. The portion of interest in this paper is the pulsed eddy current inspection used in the nondestructive phase of the work. 6 references. (auth)

**13933** (CREARE-TN-224) EFFECT OF ELEVATED PRESSURE ON ECC DELIVERY IN A SIMULATED PWR GEOMETRY. Quarterly Progress Report, July 1, 1975–September 31, 1975. Block, J. A.; Crowley, C. J. (Creare, Inc., Hanover, N. H. (USA)). Oct 1975. Contract AT(49-24)-0162. 47p. Dep. NTIS $5.00.

As part of a continuing effort to develop analytical and empirical tools to permit prediction of water delivery to the lower plenum during a postulated LOCA, tests were conducted in a $\frac{1}{15}$-scale, cylindrical vessel at pressures up to 75 psia. The experiments included tests of countercurrent flow downcomer penetration and of lower plenum voiding, both separately and combined. Countercurrent flow tests, performed at constant pressures of 35, 55 and 75 psia (and in a mode where the plenum pressure varied along a penetration curve), revealed no major surprises at elevated pressure. The dimensionless parameters used previously to correlate the data were found to be still valid. 7 references. (auth)

**13934** (DLCS-5000175) QUARTERLY OPERATING REPORT, First Quarter, 1975. (Duquesne Light Co., Shippingport, Pa. (USA). Power Stations Dept.). 1975. Contract AT(11-1)-292. 13p. Dep. NTIS $4.50.

During the first quarter of 1975, the Shippingport Atomic Power Station remained shutdown for PWR/LWBR (Pressurized Water Reactor/Light Water Breeder Reactor) Core Conversion. Defueling operations continued throughout the quarter. A nitrogen purge of the upper reactor vessel was initiated on January 3, and then on January 10, the reactor vessel water level was lowered to a level between elevation 706'9" and 707'2". This level has been maintained the remainder of the quarter. The RWD gaseous waste system remained vented to atmosphere throughout the first quarter report period. (auth)

**13935** (DLCS-5000275) QUARTERLY OPERATING REPORT, Second Quarter, 1975. (Duquesne Light Co., Shippingport, Pa. (USA). Power Stations Dept.). 1975. Contract AT(11-1)-1292. 12p. Dep. NTIS $4.50.

During the second quarter of 1975, the Shippingport Atomic Power Station remained shutdown for PWR/LWBR (Pressurizer Water Reactor/Light Water Breeder Reactor) core conversion. On April 1, the 1C loop primary side was drained and the 1C coolant pump was placed under a nitrogen purge. The BD core removal cooling system remained in service on the 1B loop. Defueling operations continued throughout the quarter. The reactor vessel head was removed on June 16. Since PWR Core 2 operations have been terminated, spare, unirradiated PWR Core 2 seed and blanket assemblies were shipped off-site during this quarter. (auth)

**13936** (DLCS-5000474) QUARTERLY OPERATING REPORT, Fourth Quarter 1974. (Duquesne Light Co., Shippingport, Pa. (USA)). 1974. Contract AT(11-1)-292. 13p. Dep. NTIS $4.50.

During the fourth quarter of 1974, the Shippingport Atomic Power Station was shutdown for PWR/LWBR (Pressurized Water Reactor/Light Water Breeder Reactor) Core Conversion. On December 26 while performing a cooldown, following a heat-up test, an operational incident occurred during which the cooldown rate exceeded the $10^0$F/hour allowable limit. A cooldown rate of $13^0$F to $14^0$F/hour was experienced for a two hour period. After an evaluation of this incident, it was concluded that no deleterious effects to the primary coolant system occurred. Defueling operations continued during the fourth quarter. (auth)

**13937** (INIS-mf-1747) CALCULATIONS OF THE CRITICAL MASS, NEUTRON FLUX AND TEMPERATURE DISTRIBUTION IN THE PWR REACTOR CORE. Morales B, J.A. (Universidad Nacional Autonoma de Mexico, Mexico City. Facultad de Ciencias). 1974. 147p. (In Spanish). INIS.

The critical mass and the neutron flux in a pressurized water reactor were calculated by using the diffusion equation in the thermal energy group. It was assumed that the core consists of four regions: three of fuel-moderator of which one is 93% enriched in $U^{235}$ and the other two of natural uranium and water, and the fourth the water reflector-moderator. The power relations between the different regions of fuel-moderator are calculated using the neutron flux obtained for a hot-clean reactor. This allows the calculation of the heat generated, the mass flow, the

flow velocity, and the heat transfer coefficients for each one of the regions. The latter was obtained by applying the correlations proposed by Dittus-Roelter and by Weisman. The general equation of heat conduction is solved and the mean temperature distribution is determined for each one of the regions within the reactor core. These results are compared with results published for the PWR used as a model. Within the approximations made the results are satisfactory in that the methods illustrate the procedure for the determination of the temperature distribution. (tr-INIS)

**13938** PLUTONIUM DEMONSTRATION ASSEMBLIES IN THE CNA CORE. Romain, J. L. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie France)). pp 147-149 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The SENA (Societe d'Exploitation Nucleaire des Ardennes) has decided to load two plutonium assemblies at the beginning of the 6th cycle of the CNA (Centrale Nucleaire des Ardennes). These assemblies will be loaded in September 1975 and will undergo three irradiation cycles. A general description of these two assemblies and nuclear design calculations that have been performed are presented. (FR)

**13939** PWR ELECTRICAL SUPPLY OPERATING RULES DETERMINED BY PROBABILISTIC APPROACH. Blin, A.; Carnino, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire); Boursier, M.; Greppo, J. F. (Electricite de France, 75 - Paris. Service de la Production Thermique). pp 179-181 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The 6.6 kV(e) supply of the safety systems for 900 MW(e) PWR plants is achieved by four redundant sources either external or internal to the plant site. The method presented gives by a probabilistic approach, a means to determine the acceptable delays for functioning when one (or more) of the four sources is unavailable. Power operation values between 12 to 36h when an external source is unavailable and between 150 to 240 h in the event of unavailability of one external source were obtained. (FR)

**13940** ECCS CRITERIA CONSEQUENCES FOR THE FRAMATOME NUCLEAR POWER PLANTS. Oullion, J. (Societe Franco-Americaine de Constructions Atomiques (FRAMATOME), 92 - Courbevoie (France)). pp 192 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

It is shown that the present ECCS model improvements obtained through the experimental programs compensate for the impact of the final ECCS criteria and so far authorize the full power capabilities of the Framatome nuclear power plants. (FR)

**13941** ATMOSPHERIC COOLING OF NUCLEAR POWER PLANTS. Comparison Between Dry and Wet Cooling. Mayor, J. C. (Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland)). pp 176-178 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The problems that arise when cooling towers are used for large nuclear power plants are analyzed under technical and economic aspects. Only known and proven cooling tower designs have been considered. It has been shown that for a PWR power plant of about 900 MW(e) with dry cooling towers, the cost of the electric energy produced is of the order of 4% above that of a similar plant with wet cooling towers. (FR)

**13942** PLUTONIUM RECYCLE CONCEPT FOR RCC: TYPE PWRs. Bonet, H.; Charlier, A.; Deramaix, P.; Vanderberg, C. (Societe Belge pour l'Industrie Nucleaire, Brussels). pp 149-152 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Self-generated Pu recycling schemes in RCC-type PWRs have been defined. The main results of survey studies performed to compare the relative merits of various Pu recycle strategies and the merits of alternative solutions of the assembly design such as the Pu-island assembly are presented. (FR)

**13943** PRESSURIZED LIQUID-COOLANT NUCLEAR-REACTOR. Costes, D. (to CEA). French Patent 2,223,792/A/. 30 Mar 1973. 13p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

This reactor is characterized in that it comprises a vertical-axis concrete vessel with a bell opened at the lower portion. The bell is coaxially mounted within the vessel and defines with the latter a space filler with a pressurized gas. This reactor combines with an integrated device in the reactor vessel for pressurizing the coolant a thermal insulation bell whereby the vessel wall is kept cool. (FR)

**13944** CONSTRUCTION OF NUCLEAR POWER PLANTS WITH PWR REACTORS IN THE U. S. AND IN WESTERN EUROPE. Kadlec, J. Jad. Energ.; 20: No. 11, 382-387(Nov 1974). (In Czech).

Experience is assessed of the construction of nuclear power plants with PWR reactors in the USA and in the Federal Republic of Germany (commercial aspects, standardization, quality assurance, design activities, fuel, and research and development of PWR reactors). (INIS)

**13945** CORROSION OF STEAM GENERATOR TUBING IN OPERATING PRESSURIZED WATER REACTORS. Weeks, J. R. (Atomic Energy Commission, Washington, DC). pp 322-345 of Corrosion Problems in Energy Conversion and Generation. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974). See CONF-7410138-.

Corrosion of steam generator tubing has been observed in all but three PWR's that have been in operation for more than one year. The history of this experience with both stainless steel and Inconel-600 tubing is reviewed. Both intergranular stress corrosion cracking and localized, transgranular wastage have been observed with Inconel-600 tubing. The wastage can be attributed to a localized concentration, or "hideout" of phosphates in limited flow areas. A model is proposed for this wastage phenomenon which is consistent with operating experience. 33 references. (auth)

## Power Reactors, Non-Breeding, Graphite Moderated

*Refer also to abstracts 13912, 14080, 14107, 14126–14128, 14144, 14191, and 14204.*

**13946** (AAS-75-283) NUCLEAR POWER IN THE SHUTTLE ERA. Ross, S. R. (American Astronautical Society, Tarzana, Calif.). Aug 1975. 16p. (CONF-750872-3). American Astronautical Society, Tarzana, CA.

From 21st annual meeting on space shuttle missions of the 80's; Denver, Colorado, USA (26 Aug 1975).

Nuclear power is expected to represent about 25 percent of electric capacity in the United States by 1985. Light water reactors will be the predominant type installed in the country by that time. The High Temperature Gas-Cooled Reactor (HTGR) is expected to assume a significant role in nuclear power production by the latter part of the 1980's. A description is presented of the Fort St. Vrain Nuclear Generating Station of Public Service Company of Colorado, the first commercial nuclear plant with an HTGR. The thermal light water reactors and HTGR's are expected to be supplemented by fast breeder reactors in the future. (auth)

**13947** (BNWL-SA-5345) RADIOLYTIC REACTIONS IN THE COOLANT OF HELIUM COOLED REACTORS. Tingey, G. L.; Morgan, W. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 12p. (CONF-751007-6). Dep. NTIS $4.50.

From IAEA international meeting on gas-cooled reactors; Julich, F. R. Germany (13 Oct 1975).

The success of helium cooled reactors is dependent upon the ability to prevent significant reaction between the coolant and the other components in the reactor primary circuit. Since the thermal reaction of graphite with oxidizing gases is rapid at temperatures of interest, the thermal reactions are limited primarily by the concentration of impurity gases in the helium coolant. On the other hand, the rates of radiolytic reactions in helium are shown to be independent of reactive gas concentration until that concentration reaches a very low level. Calculated steady-state concentrations of reactive species in the reactor coolant and core burnoff rates are presented for current U. S. designed, helium cooled reactors. Since precise base data are not currently avail-

able for radiolytic rates of some reactions and thermal reaction rate data are often variable, the accuracy of the predicted gas composition is being compared with the actual gas compositions measured during startup tests of the Fort Saint Vrain high temperature gas-cooled reactor. The current status of these confirmatory tests is discussed. 12 references. (auth)

**13948** (GA-A-13486) POSTIRRADIATION EXAMINATION OF CAPSULES HT-24 AND HT-25. Johnson, W. R.; Hamner, R. L.; Robbins, J. M.; Montgomery, B. H. (General Atomic Co., San Diego, Calif. (USA)). 15 Sep 1975. Contract E(04-3)-167. 52p. Dep. NTIS $5.45.

Results are presented of an experiment to compare the irradiation performance of a variety of graphite particles that are candidates for shim particles in Large High-Temperature Gas-Cooled Reactor (LHTGR) fuel manufacture. The shim particles were incorporated into simulated fuel compacts and the compacts were irradiated in the High Flux Isotope Reactor (HFIR) at the Oak Ridge National Laboratory. The shim particles were supplied jointly by GA and ORNL. (auth)

**13949** (GA-A-13539) REFLECTOR DOWEL STRENGTH TEST, FORT ST. VRAIN. Doll, D. W. (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1975. Contract E(04-3)-633. 20p. Dep. NTIS $4.00.

The strength of the 44.45 mm (1.75 in.) diameter Fort St. Vrain (FSV) reflector dowel for loads directed radially inward toward the center of the element was measured. For a statically applied load, the strength exceeded 5783 N (1300 lb) in direct shear. This strength remained after load cycling 100 times to 4448 N (1000 lb), 10 times to 4893 N (1100 lb), 10 times to 5338 N (1200 lb), and two times to 5783 N (1300 lb). Typically, the deflection to ultimate failure was approximately 1.0 mm (0.04 in.). At about 3316 N (750 lb) and 0.20 mm (0.008 in.) deflection, one of the webs between the dowel and a coolant hole cracked, apparently redistributing the load. No further failure occurred up to the ultimate load of 5783+ N (1300+ lb). (auth)

**13950** (GA-A-13603) FATIGUE TESTING OF FORT ST. VRAIN CORE OUTLET THERMOMETER PENETRATION INTERNAL ATTACHMENT WELDS. Axline, J. W.; Chiger, H. D.; Ellis, J. R.; Holko, K. H.; Riccardella, P. C. (General Atomic Co., San Diego, Calif. (USA)). 5 Nov 1975. Contract E(04-3)-633. 58p. Dep. NTIS $5.45.

PCRV cooling system heat load and temperature data collected during the Fort St. Vrain Hot Flow Test and rise to 2 percent power revealed that the junction of the core outlet thermometer penetrations and the cavity liner would experience a localized elevated temperature condition at full power operation. A comprehensive structural evaluation of this condition was performed, which included a detailed stress analysis of the steel penetration/liner junction and internal attachment welds. Specimens which simulated critical welds in the vicinity of the core outlet thermometer penetrations were tested under stress levels and conditions far in excess of those anticipated in actual service. The number of cycles to specimen failure or termination of the tests in all cases exceeded the specified plant operating cycles, multiplied by a factor required by the Code, by a large margin. 6 references. (auth)

**13951** (GA-A-13606) HIGH CONVERSION HTGR FOR RESOURCE CONSERVATION. Brogli, R. H.; Hays, M. L.; Lane, R. K.; Turner, R. F. (General Atomic Co., San Diego, Calif. (USA)). 1 Oct 1975. Contract E(04-3)-167. 21p. Dep. NTIS $4.00.

The HTGR offers significant improvements in the utilization of uranium and thorium by increases in the conversion ratio of fissile nuclides. The possible tradeoffs in core design features which result in higher conversion ratios are discussed. The cost effects of fuel cycle tradeoffs affecting resource utilization are presented in graphical form. The standard commercial HTGR design shows a clear capability for achieving a conversion ratio approaching 0.8 without significant changes in core structure. A conversion ratio above 0.8 can be achieved with changes in power density. (auth)

**13952** (GA-A-13616) STRUCTURAL EVALUATION OF THE LOCALIZED ELEVATED TEMPERATURES IN THE THERMOMETER PENETRATION REGION OF THE FORT ST. VRAIN PCRV. Gotschall, H. L.; Ople, F. S.; Riccardella, P. C. (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1975. Contract E(04-3)-633. 57p. Dep. NTIS $5.45.

A structural evaluation was performed to assess the presence of a localized elevated temperature condition in the outlet coolant thermometer penetration region of the Fort St. Vrain PCRV. Thermal analyses, performed in conjunction with the review of data collected during the Hot Flow Test and rise to 2 percent power, show that concrete adjacent to the penetration-liner junction is expected to attain a high temperature of 346°F at full power operation; however, the extent of the elevated temperatures (greater than 250°F) is limited to a small portion of the concrete. The evaluation covered the PCRV, including the steel liners, penetrations, and internal attachments. (auth)

**13953** (GA-A-13677) TEST AND EVALUATION OF THE FORT ST. VRAIN DEW POINT MOISTURE MONITOR SYSTEM. Block, G. A.; Del Bene, J. V. Jr.; Gitterman, M.; Hastings, G. A.; Hawkins, W. M.; Hinz, R. F.; McCue, D. E.; Swanson, L. L.; Vavrina, J.; Zwetzig, G. B. (General Atomic Co., San Diego, Calif. (USA)). 10 Oct 1975. Contract E(04-3)-633. 103p. Dep. NTIS $5.45.

Descriptions are given of the Fort St. Vrain Dew Point Moisture Monitor (DPMM) System; the bases for the DPMM system response time requirements for safety related functions at the required reactor operating conditions; the results and evaluation of recent testing which measured the performance of the current system at simulated operating conditions; predicted response times for reactor power operation from 0 to 100 percent and a modification to provide improved response times for low-load and plant start-up conditions. (auth)

**13954** (GA-A-13692) FORT ST. VRAIN SURVEILLANCE AND TESTING PROGRAM. Quarterly Progress Report for the Period Ending September 30, 1975. (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1975. Contract E(04-3)-167. 3p. Dep. NTIS $4.00.

The preparation of the surveillance and testing program for the Fort St. Vrain Reactor is briefly reviewed. (JWR)

**13955** (GA-A-13742) STATUS REPORT ON RESERVE SHUTDOWN SYSTEM. (General Atomic Co., San Diego, Calif. (USA)). 25 Nov 1975. Contract E(04-3)-633. 43p. Dep. NTIS $4.00.

During a poison loading conversion of the reserve shutdown system, crystalline deposits were found on the surfaces of several reserve shutdown balls. The reserve shutdown balls consist of $B_4C$ particles intermixed with graphite. The specification for the material allows a small amount (0.15 percent) of $B_2O_3$ to be present in the balls. The analysis performed on balls taken from a typical hopper indicates that approximately 25 percent of the $B_2O_3$ has been leached out of the balls and crystallized into harmless boric acid crystals. The performance of the reserve shutdown system has been evaluated and found to be unaffected by the presence of the boric acid crystals. A reserve shutdown system dump test was run which indicated no change in the release capability of the system. An evaluation has been made on the performance of the reactor following a reserve shutdown system dump. The crystals on the balls will either dehydrate and convert back to $B_2O_3$ or they will vaporize and diffuse into the surrounding graphite and then convert to $B_2O_3$. Either consequence will not cause any effect on the reactivity which would compromise safety of the reactor core or cause degradation of the primary coolant system components. (auth)

**13956** (INIS-mf-1759, pp 3-21) START-UP AND INITIAL OPERATION AT POWER OF UNIT 1 OF THE LENINGRAD ATOMIC POWER STATION. Aleksandrov, A. P.; Dollezhal, N. A.; Meshkov, A. G.; Emel'yanov, I. Ya.; Murav'ev, V. P.; Bulkin, Yu. M.; Eperin, A. P.; Kramerov, A. Ya.; Kunegin, E. P.; Kulov, E. V. 1974. (In Russian)

From Jubilee conference dedicated to the twentieth anniversary of nuclear power engineering; Obninsk, USSR (25 Jun 1974).

In operating experience of nuclear plants and the future development of nuclear power production. Collection of Soviet reports on jubilee conference dedicated to the twentieth anniversary of nuclear power engineering, Obninsk, 25–27 Jun 1974. Supplement.

The construction and operational principles of the channeled U–graphite 1000 MW boiling reactor are examined. The operation of the individual components of the system and the basic characteristics of the equipment are described. The start-up steps and the initial operating period are examined. (tr-auth)

**13957** (JAERI-M-5992) PREPARATION OF HTR FUEL COMPACT BY RUBBER PRESSING. Iwamoto, K.; Tobita, T.; Masuyama, T.; Yamazoe, H. (Japan Atomic Energy Research Inst., Tokyo). Feb 1975. 20p. (In Japanese). INIS.

The fuel compact containing dummy fuel particles for a high temperature gas cooled reactor has been prepared by a rubber pressing technique, to study feasibility of the method. In this process, the pressure is applied all around the mixture; in contrast with the conventional metal-molding in which the pressure is longitudinal. The product prepared has high density and good uniformity; shrinkage in sintering is small and uniform. The compact can be prepared in any size without limit in a diameter, and by making thick cladding a sleeve itself can also be prepared at the same time. (auth)

**13958** (LA-6157-MS) CROSS SECTION SPACE SHIELDING IN DOUBLE HETEROGENEOUS HTGR SYSTEMS. Stamatelatos, M. G. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 12p. Dep. NTIS $4.00.

Collision probability methods using rational approximations for space shielding of cross sections in nuclear reactor codes allowing for one level of heterogeneity are first reviewed. A Dancoff factor for a cylindrical HTGR fuel pin with grain structure is then derived. A new simple method for cross section space shielding in a doubly heterogeneous HTGR system using collision probabilities and rational approximations is subsequently presented and calculations based on it are compared with calculations based on more elaborate methods. 39 references. (auth)

**13959** PROCESS FOR THE FABRICATION OF FUEL ELEMENTS IN GRAPHITE MODERATOR BLOCKS AND FUEL ELEMENTS OBTAINED BY THIS PROCESS. Lefevre, R. L. R. (to Commission of the European Communities). French Patent 2,223,794/A/. 22 Mar 1974. Priority date 28 Mar 1973, United Kingdom of Great Britain and Northern Ireland (UK). 9p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

A procedure is described for the fabrication of fuel elements and the characteristics of fuel elements obtained by this procedure are also described. The procedure is characterized by the use of an injection system having long wire filaments introduced into a graphite block with channels for the nuclear fuel and the coolant circulation. The filaments are introduced so that during the extrusion of the viscous material with the nuclear fuel they descend into the graphite block to assure its filling. The graphite block with the nuclear fuel is then thermally treated to eliminate the binder of the viscous mixture. This procedure is particularly suitable for the formation of fuel elements consisting of particles coated with a material to retain the fission products in a moderator graphite block. (tr-FR)

**13960** INVESTIGATION OF REACTOR PHYSICAL CHARACTERISTICS DURING START-UP OF UNIT I OF THE BILIBIN ATOMIC POWER STATION. Vaimugin, A. A.; Bondarenko, V. V.; Goryunov, V. K. At. Energ. (USSR); 39: No. 1, 3-8(Jul 1975). (In Russian).

Reactor loading via fuel channels was carried out in two stages. First, the critical state was achieved by withdrawing absorbing rods. At the center of the reactor, there were installed consecutively four critical assemblies: with and without water in the fuel channels, but without control rods in the core; then the same for standard channel lattices. Channel efficiencies and space distributions of the critical assemblies were measured. The reactivity reserve, power distribution, efficiencies of absorbing rods of fuel and control rod channels, and the effect of water on the reactivity in these channels were studied after total reactor loading. It is noted that the basic physical reactor characteristics correspond to design values. (auth)

**13961** CORROSION AND FATIGUE OF SUPER ALLOYS IN SIMULATED HTGR HELIUM ENVIRONMENT AT VERY HIGH TEMPERATURES. Kondo, T.; Kikuyama, T.; Shindo, M. (Japan Atomic Energy Research Inst., Tokai-mura). pp 163-178 of Corrosion Problems in Energy Conversion and Generation. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974). See CONF-7410138-.

Corrosion and its effect on fatigue in some commercial super alloys in helium-base environments were studied. The helium-base mixtures were prepared for chemically simulating the HTGR coolant in which the alloys were tested. The low oxidizing potential in the helium caused selective oxidation of specific alloy constituents at elevated temperatures, and intergranular attack as well as loss of oxide adherence resulted. The roles of alloy constituents and the chemical condition of the environment investigated in connection with the kinetics of corrosion, the surface morphology, the transport of nuclear-hazardous species and the corrosion-assisted fracture. 8 references. (auth)

## Power Reactors, Non-Breeding, Otherwise Moderated

*Refer also to abstract 14080 and 14202.*

**13962** (AECL-5024) LIQUID ABSORBER EXPERIMENTS IN ZED-2. McDonnell, F. N. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Jul 1975. 76p. Dep. NTIS (US Sales Only) $5.50. AECL $2.00.

A series of liquid absorber experiments was performed in ZED-2 to provide data with which to test the adequacy of calculational methods for zone controller and refueling studies associated with advanced reactor concepts. The absorber consisted of a full length aluminium tube containing either $H_2O$, $H_2O$ and boron (2.5 mg/ml), or $H_2O$ and boron (8.0 mg/ml). The tube was suspended vertically at interstitial or in-channel locations. A U-tube absorber was also simulated using two absorber tubes with appropriate spacers. Experiments were carried out at two different square lattice pitches, 22.86 and 27.94 cm. Measurements were made of the reactivity effects of the absorbers and, in some cases, of the detailed flux distribution near the perturbation. The results from one calculational method, the source-sink approach, were compared with the data from selected experiments. (auth)

**13963** (AECL-5181) SPACE-TIME KINETICS OF CANDU SYSTEMS. Dastur, A. R.; Buss, D. B., (Atomic Energy of Canada, Ltd., Mississauga, Ontario). Jul 1975. 44p. Dep. NTIS (US Sales Only) $5.00. AECL $1.00.

Characteristics of CANDU (Canada Deuterium Uranium) systems which affect space dependent neutron transients have been studied. Major factors have been found to be neutronic decoupling of reactor segments due to deliberate flattening of the power distribution, retardation of the power shape transient due to delayed neutron holdback, photoneutron production in heavy water, asymmetric insertion of reactivity devices. A full-scale excursion analysis in 3-dimensions is presented to show the degree and manner in which these characteristics contribute to produce the overall spatially dependent neutron transients when a detailed model of the system is used in the simulation. (auth)

**13964** AN MHD ENERGY STORAGE SYSTEM COMPRISING A HEAVY-WATER PRODUCING ELECTROLYSIS PLANT AND A $H_2/O_2$/CsOH MHD GENERATOR/STEAM TURBINE COMBINATION TO PROVIDE A MEANS OF TRANSFERRING NUCLEAR REACTOR ENERGY FROM THE BASE-LOAD REGIME INTO THE INTERMEDIATE-LOAD AND PEAKING REGIMES. Townsend, S. J.; Koziak, W. W. (SJT Consultants Ltd., Thornhill, Ont.). pp 983-989 of Hydrogen Energy. Part B. Veziroglu, T. N. (ed.). New York; Plenum Publishing Corp. (1975).

From hydrogen economy Miami energy conference; Miami Beach, Florida, USA (18 Mar 1974). See CONF-740306-PB.

The concept is presented of the MHD Energy Storage System, comprising a heavy-water producing electrolysis plant for electricity absorption, hydrogen/oxygen storage and a high-efficiency MHD generator/steam turbine unit for electricity production on demand from the grid. The overall efficiency at 56 to 60 percent is comparable to pumped storage hydro, but at only one-half to two-thirds the capital cost and at considerably greater freedom of location. The MHD Energy Storage System combined with the CANDU nuclear reactor in Canadian use can supply all-nuclear energy to the grid at a unit energy cost lower than when oil or coal fired plants are used in the same grid. (auth)

**13965** LIMITATIONS OF RAPID CHANGES IN THE A-TYPE NUCLEAR POWER PLANT OUTPUT RESULTING FROM THE PROPERTIES OF THE KS-150 REACTOR CORE. Novak, S.; Budinsky, M. Bull. EGU; No. 78, 1-4(1971). (In Slovak).

The effect is described of $^{135}Xe$ at output changes in the KS-150 reactor. The calculation is presented of reactivity changes at the possible modes of operation. (INIS)

**13966** IODINE INDUCED CRACKING OF ZIRCALOY FUEL CLADDING: A REVIEW. Cox, B.; Wood, J. C. (Chalk River Nuclear Labs., Ontario). pp 275-321 of Corrosion Problems in Energy Conversion and Generation. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974). See CONF-7410138-.

The evidence available on the factors affecting the stress corrosion cracking (SCC) of the Zircaloys in iodine at elevated temperatures is summarized. Cold work and irradiation hardening increase the susceptibility to SCC but other factors such as surface oxide conditions, crystallographic texture and residual stresses can also have appreciable effects. Evidence from fuel element testing together with the results of laboratory tests are now sufficient to permit the definite conclusion that fuel failures that occur after the sudden uprating of fuel elements can be caused by stress corrosion cracking. 48 references. (auth)

## Power Reactors, Breeding

*Refer also to abstracts 12580, 14046, 14062, 14069, 14070, 14072, 14081, 14084, 14086–14107, 14119–14122, 14138, 14140, 14142, 14198, and 14201.*

**13967** (AERE-R-7962) FISSION PRODUCT PHASES IN IRRADIATED CARBIDE FUELS. Ewart, F. T., Sharpe, B. M.; Taylor, R. G. (UKAEA Research Group, Harwell. Atomic Energy Research Establishment). Sep 1975. 29p. Dep. NTIS (US Sales Only) $5.00. UK £1.00.

Irradiation experiments on uranium and mixed uranium-plutonium carbides are reported in which segregate fission product phases have been found and subjected to electron probe analysis. Some seven fuel pins have been examined. Two of the irradiations were in thermal materials testing reactors; the remainder were experimental assemblies of carbide gas bonded oxycarbide and sodium bonded oxycarbide in the Dounreay Fast Reactor. All fuel pins completed their irradiation without failure. (auth)

**13968** (ANL-79-29) CONCEPTUAL DESIGN FOR A 1200-MW(e) LIQUID METAL FAST BREEDER REACTOR (LMFBR) POWER PLANT. Amorosi, A.; Fromm, L. W. (Argonne National Lab., Ill. (USA)). Jun 1975. Contract W-31-109-Eng-38. 32p. AT.

A concept is described which is a synthesis of today's experience with an integrated plant. Some features, although basically sound in principle, remain to be proven. The plant arrangement consists of a cold-leg pump, a three-loop piped system with helium cover gas, and a helium-cooled canned motor drive for the primary pump. It has a low-pressure-drop intermediate heat exchanger (IHX) based on EBR-II experience. The steam generators are contained in a building wrapped around the reactor building. This building also contains auxiliary systems that make access for inspection and repair easier than locating these systems in the area below the floor of the reactor building. The fuel-handling system is a bold but simple system. The operating temperatures of 800$^0$F sodium in and 1100$^0$F out were chosen to indicate the type of research that might be required with a 100$^0$F rise over present temperatures. A number of aspects of the design were chosen to indicate the type of research that might be undertaken to improve performance. (auth)

**13969** (ANL-RDP-43) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, SEPTEMBER 1975. (Argonne National Lab., Ill. (USA)). 3 Nov 1975. Contract W-31-109-Eng-38. 160p. AT.

Progress is summarized in the following research and development areas: Experimental Breeder Reactor No. 2, Fuels and Materials Development, Reactor Physics, Reactor Safety, and GCFR design. (auth)

**13970** (ANL-Trans-1012) RESEARCH ON THE RESPONSE OF CYLINDRICAL SHELLS TO HYDRODYNAMIC EXCITATIONS. Levin, L.; Milan, D.; Payan, G. Translated by Jacqueline Banfield from Houille Blanche; 26: No. 6, 505-512(1971). 22p. Dep. NTIS $4.50.

The Phenix reactor is used to illustrate a method of investigating the response of certain cylindrical structures to the random pressure fluctuations resulting from turbulent fluid flow. The excitations were determined using a hydraulic model, and the vibratory characteristics were determined from the overall behavior of a mechanical model. It is shown how current random shell vibration theory can be used to calculate the response. Formulas giving two upper response limits are easily derived, as the excitation power spectrum density is constant over the shell surface considered, and simple to express mathematically. (FR)

**13971** (ANL-Trans-1014) SIMULATOR OF THE PHENIX POWER PLANT. Fourcade, C. Translated by J. Hamlin From Bull. Instrum. Nucl.; No. 43, 37-38(Mar 1971). 4p. Dep. NTIS $4.50.

This simulator, installed at Cadarache, is intended to familiarize operators with the dynamic behavior and the startup and shutdown procedures of the plant. The requirements sought were maximum simplicity, reliability and a capability of simulating the low transients of the power plant. This simulator consists of an E.A.I. 8945 hybrid unit and a control desk for monitoring the control rods of the primary and secondary coolant loops, the emergency shutdowns, and the water flow rate in the vapor generator. (FR)

**13972** (ANL-Trans-1015) PHENIX POWER PLANT WORK ON THE SITE. Labat, M. P.; Gregut, A. Translated by Julie Hamlin from Energ. Nucl. (Paris); 13: No. 3, 213-217(1971). 12p. Dep. NTIS $4.50.

The site preparation and excavation, foundation work, and plant construction and assembly at the Phenix Reactor are described. (JWR)

**13973** (ANL-Trans-1016) FLUCTUATING HYDRODYNAMIC FORCES IN THE TANKS OF THE PHENIX REACTOR. Lambert, P.; Leon, P. Translated by Julie Hamlin from Houille Blanche; 26: No. 6, 499-503(1971). 11p. (CONF-710347-1). Dep. NTIS $4.50.

From meeting on some problems of hydro- and aeroelasticity; Paris, France (18 Mar 1971).

The pressure fluctuations measured on the reduced model of the Phenix reactor tanks are of uncertain characteristics in the domain of lower frequencies. The total level of fluctuations varies very little in different locations on the reactor tank wall, within the particular safe zone. By replacing the Froude number similarity by a real velocity similarity, double the average velocity, the pressure fluctuations are augmented in the ratio of average velocities rather than in the ratio of square of velocities. The spectrum analysis of energy density confirmed the previous conclusions; the direct spectrums are continuous spectrums and decrease in the lower frequency bands spreading very little beyond 10Hz. One is able to compare the spectrums of homogeneous turbulence and isotropic turbulence. Finally, the determination on the reduced model of fluctuating hydrodynamic forces by measuring pressure pulses a certain number of precautions in the building of the model and the concept of its supply, for preventing parasitic pressure fluctuations which render analysis of the results very delicate. (auth)

**13974** (ANL-Trans-1017) CONSTRUCTION OF THE EXCHANGERS AND STEAM GENERATORS OF THE FAST NEUTRON PLANT. Translated from Tech. Mod.; 3: 49-50 (Mar 1974). 7p. Dep. NTIS $4.50.

Design specifications, construction methods, and operational performance are briefly summarized. (DG)

**13975** (ANL-Trans-1018) VIBRATORY STATE OF THE FUEL TINS AND ASSEMBLIES OF THE PHENIX REACTOR. Ginier, R.; Pontier, M. Translated by Jacqueline Banfield from Houille Blanche; 26: No. 6, 513-517(1971). 14p. Dep. NTIS $4.50.

The vibrations of fuel elements immersed in Na flowing quasi-parallel to the fuel assemblies were studied as part of a program on the hydraulics associated with reactor technology. The studies were undertaken in view of ensuring that for the different element-supporting arrangements and spacings, fatigue stresses affecting the safety of the reactor will not occur. Full size models of the assembly with simulated Na flow and very similar hydraulic and mechanical considerations were used. It was verified that under normal working conditions no dangerous vibrations of the fuel elements or assembly could occur. (FR)

**13976** (ANL-Trans 1020) HYDRAULIC PROBLEMS OCCURRING IN SODIUM COOLED FAST REACTOR. Duport, J. P.; Abecassis, G.; Chenal, J. C.; Constantin, J. P.; Daubert, A.; Gama, J. M.; Lambert, P.; Leon, P.; Morin, B. Translated from Bull. Inf. A.T.E.N. (Assoc. Tech. Energ. Nucl.); No. 83, 46-57(1970). 32p. (CONF-700307-9). Dep. NTIS $5.00.

From Symposium on progress in sodium-cooled fast reactor engineering; Monaco, France (23 Mar 1970).

Isothermal hydraulics, thermohydraulics, fluctuating hydrodynamic forces, transitory hydraulics, and cavitation in LMFBR type reactors are discussed. Some experience concerning these phenomena in Phenix and Rapsodie is described. (JWR)

**13977** (CONF-750977-, pp 4.1-4.20) REACTOR CORE MODEL FOR A FAST BREEDER POWER PLANT SIMULATION. Saphier, D.; Kirsch, L. W.; Mulcahey, T. P. (Argonne National Lab., IL). 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

Since a nuclear power plant has a large number of components, even simplified models will give rise to complex simulation programs and in many cases excessive computer time (in the range of hours) is necessary to obtain the required solution. It is therefore of major practical importance to find out what is the optimal simulation method for a particular study. The term "optimal simulation method" is used with respect to computer time--the method that will use the least computer time while maintaining the required accuracy. In the present study, the required accuracy was set to 1 percent--and the optimal method for the reactor neutronics and heat transfer was sought. The present study is part of a CRBR oriented simulation under development at ANL. Although the mathematical models used were by no means new, they were analyzed as to their relative accuracy and the complexity of each module was so chosen as to give the prescribed accuracy for a particular type of transient calculation while keeping the computer time to minimum. The reactor core neutronics and heat transfer simulation were chosen for first consideration in the study because of the wide range of simulation models possible and potential computer time saving resulting from the proper choice of model. (auth)

**13978** (CONF-750977-, pp 24.1-24.18) DYNAMIC SIMULATION OF AN LMFBR STEAM GENERATOR. Bein, M.; Yahalom, R. 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

The model of a sodium heated evaporator as is used in a recirculating steam generating system is described. The thermal hydraulic equations are derived for one channel. The assumptions are stated and model limitations are discussed in detail. The uniqueness of the model is the utilization of the moving mesh approach to solve the conservation equations. Some results are presented and the overall usefulness of the model is discussed. (auth)

**13979** (CONF-751065-1) STATUS OF THE US PROGRAM FOR DEVELOPMENT OF THE MOLTEN-SALT BREEDER REACTOR. McNeese, L. E. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France)). 1975. 23p. Dep. NTIS $4.50.

From meeting on molten-salt breeder reactor development; Fontenay-aux-Roses, France (13 Oct 1975).

**13980** (CONF-751101-55) NUCLEAR CHARACTERISTICS OF A 1000-MW(e) MOLTEN-SALT BREEDER REACTOR. Engel, J. R.; Kerr, H. T.; Allen, E. J. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. 14p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Included are brief discussions of the MSBR reference concept, core neutronics, core design, breeding and resource utilization, and reactor kinetics. (DG)

**13981** (COO-2245-25) COOLANT MIXING IN LMFBR ROD BUNDLES AND OUTLET PLENUM MIXING TRANSIENTS. Progress Report, June 1, 1975–August 31, 1975. Todreas, N. E.; Golay, M. W. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1975. Contract AT(11-1)-2245. 38p. Dep. NTIS $4.00.

Information on coolant mixing in LMFBR core regions is presented concerning LMFBR outlet plenum flow mixing, subchannel geometry (bare rods), and bundle geometry (wrapped and bare rods). (DCC)

**13982** (COO-2250-15) MIT LMFBR BLANKET RESEARCH PROJECT. Quarterly Progress Report, April 1, 1975–June 30, 1975. Driscoll, M. J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1975. Contract AT(11-1)-2250. 13p. Dep. NTIS $4.50.

Research progress on physics experiments and calculations for LMFBR breeding blankets is briefly reported. (JWR)

**13983** (COO-2250-16) MIT LMFBR BLANKET RESEARCH PROJECT. Quarterly Progress Report, July 1, 1975–September 30, 1975. Driscoll, M. J. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). 1975. Contract AT(11-1)-2250. 11p. Dep. NTIS $4.50.

Research progress on physics experiments and calculations for LMFBR breeding blankets is briefly reported. (JWR)

**13984** (EURFNR-1246) DESIGN, IRRADIATION, AND POST-IRRADIATION EXAMINATION OF $UO_2/PuO_2$ FUEL PINS IRRADIATED IN EXPERIMENT Mol 8B. Weimar, P.; Sebening, H. (Kernforschungszentrum Karlsruhe (F. R. Germany)). Jan 1975. Translation of KFK-2106. 116p. Dep. NTIS $6.50.

Included are data on the fuel pin design, specifications, and fabrication as well as a detailed description of irradiation and post irradiation examination results. (auth)

**13985** (GEAP-14045-3) RELIABILITY PROGRAM FOR SHUTDOWN HEAT REMOVAL. Third Quarterly Report, June–August 1975. (Princeton Univ., N. J. (USA). Plasma Physics Lab.). Sep 1975. Contract E(04-3)-893. 33p. AT.

Reliability studies of LMFBR shutdown heat removal systems are reported. Activities include completion of a preliminary reliability allocation and apportionment for LMFBR shutdown heat removal systems, and completion of the test plan definition for the shutdown heat removal and structural reliability program. In addition, a probabilistic data report was prepared which provides the failure rate for all failure modes of each component necessary for shutdown heat removal using a probabilistic data sheet for each event. A description of the failure, the basis for the failure rate, and any revision history are given on each sheet. These failure rates were used in the quantitative reliability analysis of LMFBR shutdown heat removal systems. (auth)

**13986** (HEDL-SA-766) REFRACTORY METAL CARBIDE COATINGS FOR LMFBR APPLICATIONS: A SYSTEMS APPROACH. Gotschall, H. L.; Ople, F. S.; Riccardella, P. C. (Union Carbide Corp., Tonawanda, N. Y. (USA). Linde Div.; Westinghouse Hanford Co., Richland, Wash. (USA)). 10 Feb 1975. 28p. (CONF-750234-2). Dep. NTIS $4.00.

From conference on structure-property relationship in thick film bulk coatings; San Francisco, California, USA (10 Feb 1975).

The selection, testing and improvement of high density, tightly bonded plasma and detonation gun coatings designed to meet LMFBR core component criteria are described. The process descriptions include a review of the important developments in substrate surface preparation which were required to ensure strong bonding and to minimize interface contamination. Coating finishing techniques which were developed to optimize friction behavior are also described. (auth)

**13987** (HEDL-SA-7955) LIFETIME PREDICTIONS FOR MIXED OXIDE LMFBR FUEL PINS CLAD WITH TYPE 304 STAINLESS STEEL. Jackson, R. J.; Saito, G. H.; Cox, C. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jun 1975. 5p. (CONF-750607-38). Dep. NTIS $3.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

A method of predicting fuel pin lifetimes is described for stainless steel clad mixed oxide LMFBR fuel pins at cladding temperatures below about $1100^0$F. The development of this method required (1) determining empirical relations for in-reactor fuel pin cladding stress and creep rates based on reported strains of EBR-II driver fuel pins, and (2) applying the in-reactor creep equation to mixed oxide fuel pins. Good agreement was obtained between calculated and measured in-reactor creep strain and between an in-reactor strain to failure correlation and observed failures in mixed oxide fuel pins clad with 304 stainless steel. An in-reactor creep relationship for the temperature range $700^0$F to $1050^0$F was developed using reported cladding mechanical strain data for the EBR-II metal fueled, driver fuel pins. (auth)

**13988** (HEDL-TME-75-1) HEDL QUARTERLY TECHNICAL REPORT, JANUARY, FEBRUARY, MARCH 1975. Noordhoff, B. H.; Weber, S. A.; Trego, A. L.; Yatabe, J. M. (Hanford Engineering Development Lab., Richland, Wash. (USA)). May 1975. Contract AT(45-1)-2170. vp. AT.

Progress is reported in the areas of FFTF and LMFBR test program engineering, control and data systems, reactor instrument development, reactor engineering, and nondestructive testing engineering. (DG)

**13989** (HEDL-TME-75-71) LMFBR REFERENCE CONTROL MATERIALS SEMIANNUAL REPORT. Burgess, C. A.; Sheely, W. F. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-2170. 40p. AT.

Progress on neutron absorber development activities from January, 1975 through June, 1975 is presented. Included are descriptions of activities related to performance analysis, development testing, and fabrication technology. (auth)

**13990** (HEDL-TME-75-94) INLET PLENUM FEATURE MODEL FLOW TEST OF THE CLINCH RIVER BREEDER REACTOR: INITIAL RESULTS. McConnell, P. M.; Spalek, J.; Mech, S. F. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract AT(45-1)-2170. vp. AT.

The IPFM models all hydrodynamically important wetted surfaces in a full $360^0$ (0.248 scale) sector of the inlet plenum and lower internal components of the CRBR. Differential pressures, core flow distribution, and turbulent mixing parameters are reported for each of six inlet plenum configurations. The data, obtained from an inlet plenum configuration with a core support structure (CSS) which did not contain the current CSS Auxiliary Flow Port Liner concept, show that the IPFM flow performance is acceptable according to the criteria established by the Designer (ARD). The test results also indicate that the plenum can possibly be shortened by about ten inches without significantly changing the pressure drop, flow distribution, and mixing characteristics. 6 references. (auth)

**13991** (IFA-FR-104-1973) CRITICALITY STUDIES OF MULTIZONE FAST BREEDER REACTORS IN COUPLE $^{238}U$–$^{239}Pu$. Pavelescu, M.; Adam, S.; Purica, I. (Institutul de Fizica Atomica, Bucharest (Romania)). 1973. 21p. INIS.

Criticality studies of fast breeder reactors of spherical geometry within the two-group diffusion approximation are reported. Each reactor is supposed to consist of several homogeneous concentric zones of different composition. The two-group neutron flux equations are rigorously solved for an arbitrary zone, and a criterion is given for the determination of the character of the zone. Further, a solution which can be evaluated numerically is obtained for the neutron flux spectrum over the entire reactor range. This solution is normalized to the maximum reactor power density. Numerical results are reported for two- and three-zone fast reactors corresponding to several fissile material and fertile

material strategies. Calculations have been made for 118 reactors of small dimensions, each reactor containing a same amount of fertile material, for which the diffusion approximation is known to be valid. The results show that three-zone reactors exist which are more advantageous than the usual two-zone reactors, from the point of view of the breeding properties. (auth)

13992 (LA-6028) EXPERIENCE RELATED TO THE SAFETY OF ADVANCED LMFBR FUEL ELEMENTS. Kerrisk, J. F. (Los Alamos Scientific Lab., N. Mex. (USA)). Jul 1975. Contract W-7405-Eng-36. 29p. Dep. NTIS $4.00.

Experiments and experience relative to the safety of advanced fuel elements for the liquid metal fast breeder reactor are reviewed. The design and operating parameters and some of the unique features of advanced fuel elements are discussed briefly. Transient and steady state overpower operation and loss of sodium bond tests and experience are discussed in detail. Areas where information is lacking are also mentioned. (auth)

13993 (ORNL-TM-5142) SPECIFICATION FOR PSEUDO-COMPOSITION-INDEPENDENT FINE-GROUP AND COMPOSITION-DEPENDENT FINE- AND BROAD-GROUP LMFBR NEUTRON-GAMMA LIBRARIES AT ORNL. Weisbin, C. R.; Roussin, R. W.; White, J. E.; Wright, R. Q. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 18p. (ENDF-224). AT.

Specifications are presented for pseudo-composition independent fine-group and broad-group LMFBR neutron-gamma libraries. A one-dimensional cylindrical model of the CRBRP is used to derive the fine- and broad-group composition-dependent data. Energy boundary selection was guided by sensitivity considerations and compatibility with previously existing multigroup sets. Fast reactor data testing of CSEWG benchmark critical assemblies is summarized. (auth)

13994 (ORNL-TM-5173) FINAL REPORT OF THE LMFBR CAMPAIGN OF THE EXPERIMENTAL ENGINEERING SECTION OFF-GAS DECONTAMINATION FACILITY, MARCH–JULY 1975. Klein, J. A.; Gilliam, T. M. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 49p. AT.

Results of a four-month campaign for studying the removal of krypton from simulated Liquid Metal Fast Breeder Reactor reprocessing off-gas are presented. The experiments were performed in the Experimental Engineering Section Off-Gas Decontamination Facility with a refrigerant 12-$N_2$-Kr system. The experiments performed indicate values of HTU for krypton into liquid fluorocarbon on the order of 0.33 ft. These engineering scale experiments achieved decontamination factors of from 5 to 10,000 with gas flows up to 3.6 scfm with a nominal liquid flow of 0.3 gpm. 8 references. (auth)

13995 (SAND-75-0556) PRESSURE PREDICTIONS FOR REACTOR FUEL PIN ASSEMBLIES WITH THE ANEOS EQUATION OF STATE. Burchett, O. L.; Beisinger, Z. (Sandia Labs., Albuquerque, N. Mex. (USA)). Nov 1975. Contract AT(29-1)-789. 15p. Dep. NTIS $4.00.

ANEOS, the CHART D analytical equation of state was used to calculate the equilibrium pressure in a reactor fuel pin assembly that is produced by a neutron pulse. Details of the calculational procedure and the pressures that were calculated for the PBE experiment are presented. (auth)

13996 (WARD-CR-3045-9) CORE RESTRAINT DEVELOPMENT. Quarterly Progress Report for Period Ending 31 May 1975. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1975. Contract E(11-1)-3045. 20p. AT.

The initial test plan for 121-assembly testing has been completed. Plans are being made to study effects of "on power" and straight assembly cores on the 121-assembly configuration. The modeling techniques used by ANL in PARABOW may be incorporated in codes used by ARD. Withdrawal force tests on single assemblies being carried out at HEDL are 90 percent complete. Plans are being made to run frictional tests on ARD test components at HEDL. (auth)

13997 (WARD-HT-3045-11) VALIDATION OF HIGH TEMPERATURE DESIGN METHODS AND CRITERIA. Quarterly Progress Report for Period Ending February 28, 1975. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Aug 1975. Contract E(11-1)-3045. 144p. AT.

Progress is reported in the testing and analysis of Type 304 and 306 stainless steel plate and tubular specimens for FFTF and LMFBR pressure-containing components. Included are data on core design methods, basic specimen testing, tubular specimen testing, structure testing, FFTF intermediate heat exchanger inlet nozzle testing, analysis methods and procedures, elevated temperature design standard, and crack propagation testing. (DG)

13998 (WARD-HT-12) VALIDATION OF HIGH TEMPERATURE DESIGN METHODS AND CRITERIA. Quarterly Progress Report for Period Ending May 31, 1975. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). 1975. Contract E(11-1)-3045. 126p. AT.

Progress is reported in the testing and analysis of Types 304 and 316 stainless steel plates and tubular specimens of FFTF and LMFBR components. Data are included on core design methods, basic specimen testing, tubular specimen testing, structure testing, FFTF intermediate heat exchanger nozzle testing, analytical methods and procedures, and crack propagation testing. (JWR)

13999 (WARD-OX-3045-17) IRRADIATION CREEP, STRESS RELAXATION AND A MECHANICAL EQUATION OF STATE. Foster, J. P. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Dec 1975. Contract E(11-1)-3045. 44p. AT.

Irradiation creep and stress relaxation data are available for M316, FV548 and PE16 using pure torsion in the absence of swelling at 300°C. Irradiation creep models were used to calculate stress relaxation and permanent deflection. Two relationships between irradiation creep and stress relaxation were assessed by comparing the measured and calculated stress relaxation and permanent deflection. The results show that for M316 and FV548, the stress relaxation and deflection may be calculated using irradiation creep models when the stress rate term arising from the irradiation creep model is set equal to zero. The post-irradiation deflection is more sensitive than the stress relaxation to the stress rate term. In the case of PE16, the inability to calculate the stress relaxation from the irradiation creep data was attributed to differences in creep behavior arising from lot-to-lot variations in alloying element and impurity contents. 15 references. (auth)

14000 (WARD-RB-3045-10) RADIAL BLANKET DESIGN AND DEVELOPMENT. Quarterly Progress Report for Period Ending May 31, 1975. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. (USA). Advanced Reactors Div.). Oct 1975. Contract E(11-1)-3045. 92p. AT.

A summary of prior work and current progress is presented in the areas of radial blanket assembly heat transfer testing, radial blanket fuel, and assembly irradiation testing, radial blanket flow orificing tests, and radial blanket rod bundle compaction tests. (DG)

14001 NUCLEAR REACTOR FUEL ASSEMBLY. Ratier, J. L.; Rousseau, J. (to Commissariat a l'Energie Atomique). French Patent 2,228,275/A/. 4 May 1973. vp. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

Description is given of an assembly comprising within an enclosure of polygonal shape, a bundle of fuel needles, maintained parallel to one another at the nodes of a regular network and each surrounded by a bracing member wound as a high pitch helix between the two end plugs of the respective needles, when provided with their bracing members. The needles belong to either of types 1 and 2, one of these types being provided with a bracing member having a diameter $d_1$ equal to the maximum spacing between adjacent needles, while the other type is provided with a bracing member with a diameter $d_2$ smaller than diameter $d_1$. Such assemblies are used for equipping power reactors. (FR)

14002 GRID STRUCTURE FOR FUEL RODS, IN PARTICULAR FOR HIGH TEMPERATURE FAST REACTORS. Bujas, R.; Taverne, H. (CEA, 75–Paris (France)); Forel, B. (Bureau d'Etudes, 91–Orsay (France)). (to Commissariat a l'Energie Atomique). French Patent 2,225,814/A/. 10 Apr 1973. 17p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

This structure is characterized in that it is constituted by elongated metal members, mounted side by side and mutually crossed so as to leave between a space in the shape of slots of small thickness, the members of the grid being mutually assembled so as to form an evenly perforated surface. This can be applied to fuel rods for high-temperature fast reactors. (FR)

14003 SPACER SUPPORTING DEVICE FOR BUNDLES OF PARALLEL TUBES. Devoucoux, P. (to Societe Stein Industrie). French Patent 2,226,607/A/. 20 Apr 1973. 9p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

Description is given of a spacer-supporting device for bundles of parallel tubes; characterized in that it comprises a carrier frame with a peripheral rim and spaced transverse parallel blades welded to said rim, and a plurality of independent parallel stiff chains inclined with respect to said transverse blades. Each

of said chains is constituted by cylindrical rings each of which surrounds respective tube of the bundle, said ring being rendered mutually integral by two lengthwise of said chain by means of spacing and aligning plane links. (FR)

**14004** MAIN VESSEL AND SAFETY ENCLOSURE FOR NUCLEAR REACTORS WITH AN INTEGRATED COOLANT LIQUID METAL CIRCUIT. (to Societe Babcock-Atlantique). French Patent 2,221,791/A/. 14 Mar 1973. 10p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France)

This reactor which comprises a main vessel tightly connected to a rigid slab forming the cover of a concrete container is characterized in that the main vessel is provided in the lower portion thereof, with a rigid bottom supporting the core and resting on the concrete container through a supporting device adapted to permit the vessel to move horizontally and radially with respect to its center, when said vessel undergoes thermal deformations, and, in the upper portion thereof, a roof-like horizontal zone located between the lateral portion of the vessel and its connection with the slab, for accomodating the vessel flection stresses. This can apply to high-power fast-neutron reactors. (FR)

**14005** FAST NEUTRON NUCLEAR REACTOR PRIMARY VESSEL. Gallo, S. (Societe pour l'Industrie Atomique (SOCIA), 75-Paris (France)); Berniolles, J. M. (CEA, 75-Paris (France)). (to Commissariat a l'Energie Atomique). French Patent 2,220,847/A/. 7 Mar 1973. 12p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

The reactor is cooled by means of liquid sodium and comprises a main vessel with a vertical axis supporting the reactor core, in turn mounted in the primary vessel providing the separation of the hot sodium issuing from the core from the cold sodium issuing from heat exchangers dipped in the main vessel, and pumps for circulating the cold sodium issuing from the exchangers and re-directed to the core. The primary vessel is characterized in that it is of revolution about the main vessel vertical axis, and comprises a lateral recess through which pass exchanger sleeves and sodium pumps, that recess being extended, outside the primary vessel, by a downturned flange, connected at the lower and thereof to the main vessel. This can be applied to reactors with a power of about 1000MW(e). (FR)

**14006** METHOD AND DEVICE FOR THE EXCHANGE OF HEAT BETWEEN MUTUALLY REACTIVE FLUIDS. (to Societe Babcock-Atlantique). French Patent 2,220,765/A/. 9 Mar 1973. 15p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

A method is described for the transfer of heat between two mutually reactive fluids, namely a primary, or heating, fluid and secondary fluid to be heated, said method consisting in transferring the primary fluid heat to an intermediate fluid by vaporizing the latter under saturated vapor pressure, transferring to the secondary fluid and heat of the thus vaporized fluid until the latter condenses, causing the condensate to be again in heat-exchange relation with the primary fluid and reproducing, in a closed circuit, the intermediate fluid vaporization and condensation steps. (FR)

**14007** FUEL-NEEDLE BUNDLES FOR NUCLEAR REACTORS. Duret, G.; Place, G.; Rousseau, J. (to Commissariat a l'Energie Atomique). French Patent 2,218,620/A/. 19 Feb 1973. 7p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

This bundle, each needle of which is provided with a cross-member wound in a high-pitch spiral on the outer surface of the needle sheath and made integral with the needle end-plugs, is characterized in that said cross-member consists of a deformable tube of constant initial cross section. This can apply to high-power fast neutron nuclear reactors. (FR)

**14008** FUEL-NEEDLE BUNDLES FOR NUCLEAR REACTORS. Duret, G.; Place, G.; Rousseau, J. (to Commissariat a l'Energie Atomique). French Patent 2,218,619/A/. 19 Feb 1973. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

This bundle, each needle of which comprises an outer cross-member wound in a high-pitch spiral on the needle outer surface and made integral with plugs adapted to close the needle ends, is characterized in that said cross-member comprises a metal wire, the diameter of which is larger at the ends thereof than in its intermediate portion. This can apply to high-power fast-neutron nuclear reactors. (FR)

**14009** PLUTONIUM CRISIS. Gruhier, F. Sci. Avenir; No. 338, 372-377(Apr 1975). (In French)

Attempts to reduce the time necessary to recover the mass of Pu invested in breeder reactors are described (reactor size, core geometry, new fuels based on carbides). Breeders are supplied at present by light-water reactors and will continue to depend on the latter for some time. (FR)

**14010** PHENIX REACTORS. Suransky, F. Jad. Energ.; 21: No. 1, 29-34(Jan 1975). (In Czech)

Technical specifications are presented of the French demonstration nuclear power plant Phénix equipped with a sodium-cooled fast reactor. Reactor start-up including unplanned outages due to failures is described and the nuclear power plant commissioning and connecting to the utility system are discussed. Reactor parameters are dealt with in more detail, supplemented with graphs and tables. (INIS)

**14011** DESIGN OF THE CORE AND SUBASSEMBLIES OF A LIQUID METAL FAST BREEDER REACTOR. Chaumont, J. M.; Clauzon, P.; Delpeyroux, P.; Estavoyer, M.; Ginier, R.; Marmonier, P.; Mougniot, J. C. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). pp 57-58 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

It is shown that the main objective in designing a power station is a minimum cost of the kWh produced and that the choice of the main parameters of a reactor is the result of a compromise. The determination of the core architecture, the shape and size of fuel pins, the thermal and hydraulic parameters and the fuel assembly design is discussed. (FR)

**14012** COMPENSATION ASSEMBLIES IN THE FIRST CORE OF SNR-300. Billaux, M.; De Wouters, R.; Pilate, S.; Vandenberg, C. (Societe Belge pour l'Industrie Nucleaire, Brussels); Spenke, H.; Stojadinovic, A.; Wehmann, U. (Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bensberg/Koeln (F. R. Germany)). pp 152-153 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

For the SNR-300 reactor, the use of thin fuel pins was limited to the first core. The new system of special assemblies conceived to compensate for the too high reactivity of the first core is described: fixed absorbers, made of $B_4C$ pins, and sodium diluents, consisting simply of hollow wrapper tubes. (FR)

**14013** CREYS-MALVILLE PLANT: SAFETY PROBLEMS CONCERNING DESIGN AND CONSTRUCTION. Le Marechal, T.; Lucenet, G. (Societe Centrale Nucleaire Europeenne a Neutrons Rapides (NERSA), 69-Lyon (France)); Meyer-Heine, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides); Chalot, A.; Malaval, C. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). pp 187 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The main safety problems concerning design and construction of Super-Phenix and the technical solutions presently adopted are discussed. (FR)

**14014** FAST REACTORS. Thermal Calculations of Annulus Application to Phenix. Kung, J. P. (Groupement pour les Activites Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)); Gama, J. M. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France)). pp 279-281 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The gas convection phenomena involved in the annuli of the penetrations of the heat exchanger of the Phenix reactor are analyzed and the calculations performed using the BINIX program developed by GAAA to study the same phenomena are presented. The theory/experience comparison led to a better understanding of thermo-siphon phenomena. (FR)

**14015** TEMPERATURES OF STRUCTURES IMMERSED IN THE PHENIX REACTOR. Daubert, O.; Malherbe, J. F. (Electricite de France, 78–Chatou. Lab. National d'Hydraulique); Gama, J. M. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France)). pp 281-283 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The temperature determination procedures developed to study the temperatures inside the Phenix reactor vessel and in particular in the inter-vessels space are presented: experimental tests on mockups and two-dimensional model calculations. The results obtained are compared with measurements carried out using 66 thermocouples fitted inside the reactor at the moment of its construction. (FR)

**14016** THERMAL-HYDRAULIC STUDIES APPLIED TO SODIUM BREEDERS. Daubert, A. (Electricite de France, 78–Chatou. Lab. National d'Hydraulique); Gollion, H. J.; Sauvage, M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13–Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides); Martin, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). pp 283-285 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Thermal hydraulic problems encountered in the design of integrated reactors such as Phenix are presented together with the arrangements adopted to solve them. (FR)

**14017** CEA BURNUP STUDIES FOR FAST NEUTRON POWER REACTORS. Barre, J. Y. (CEA Centre d'Etudes Nucleaires de Cadarache, 13–Saint-Paul-les-Durance (France). Service des Experiences Critiques et de Physique des Reacteurs); Bouchard, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). pp 138-139 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The French fast-neutron reactor physics program developed at CEA aims at defining the main characteristics of mixed-oxide sodium-cooled fast breeder plants. Two facilities are operated for the CEA burnup program: Ermine and Masurca. Irradiations of samples or standard fuel are performed in the power reactors Rapsodie, fortissimo and now Phenix. Analyses of the fuel isotopic composition variations give accurate and unique experimental information. These results, together with reactor reactivity and power variations versus burnup rate, represent a full-scale check of burnup calculations. (FR)

**14018** TUBE HEAT EXCHANGER. Richardson, J. (to UKAEA). French Patent 2,225,710/A/. 12 Apr 1974. 8p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France); priority claim: 16 Apr 1973, UK.

The invention concerns a tube heat exchanger in which the tubes are joined on cylindrically shaped tube plates. A partition forms a double envelop whose two walls can be differentially dilated. It is applicable to the extraction of heat from the coolant sodium of nuclear reactors. (tr-FR)

**14019** INVESTIGATION OF EXPERIMENTAL CARBIDE FUEL ELEMENTS IN REACTOR BOR-60 TO BURNUPS OF 3 AND 7% OF HEAVY ATOMS. Davydov, E. F.; Maershin, A. A.; Syuzev, V. N.; Bibilashvili, Yu. K.; Golovnin, I. S.; Men'shikova, T. S. At. Energ. (USSR); 39: No. 1, 33-36(Jul 1975). (In Russian).

The results of investigating two fuel-element assemblies based on uranium monocarbide irradiated in reactor BOR-60 to burnups of 3 and 7% of heavy atoms are presented. Problems of gas release and dimensional and structural stability of fuel elements and fuel are considered. Interaction estimates for two types of contact layer are presented. (auth)

**14020** BOILING CRISIS IN A STEAM-GENERATING TUBE HEATED BY A LIQUID METAL HEAT CARRIER. Nekrasov, A. V.; Logvinov, S. A.; Testov, I. N. At. Energ. (USSR); 39: No. 1, 20-23(Jul 1975). (In Russian).

Over a wide range of pressures and mass flow rates, values of the boundary steam quality to describe the boiling crisis of the second kind for water boiling in tubes have been obtained. It has been established that the boundary steam quality does not depend on the kind of heating and the heat flux distribution along the axis of a tube. For a pressure of 147 bar and several mass flow rates, experimental data on intensity and spectral density temperature fluctuations in the crisis zone have been obtained. The extent of the fluctuation zone along the axis and circumference of the tube have been determined. It has been found that the fluctuation intensity and spectral composition significantly depend on whether sub-cooled water or a steam-water mixture flows into the test section. The experimental data obtained are necessary for evaluating the capacity of single-pass steam generators heated by liquid metals. (auth)

**14021** CORROSION STUDIES FOR THE SODIUM COOLED FAST BREEDER REACTOR PROGRAM. Schrock, S. L.; Whitlow, G. A. (Westinghouse Electric Co., Madison, PA). pp 225-239 of Corrosion Problems in Energy Conversion and Generation. Tedman, C. S. Jr. (ed.). Princeton, NJ; Electrochemical Society, Inc. (1974).

From proceedings of the symposium on corrosion problems in energy conversion and generation; New York, New York, USA (15 Oct 1974). See CONF-7410138-.

Materials presently identified for the Liquid Metal Cooled Fast Breeder Reactor (LMFBR) are primarily iron-base alloys such as Types 304 and 316 stainless steels or the ferritic $2\frac{1}{4}$Cr–1Mo alloy. Nickel base materials, such as Inconel 718, are also used to some extent for specialized applications requiring high strength and moderately good thermal fatigue resistance. Although the iron and nickel base materials are relatively inert to the sodium coolant under normal operating conditions, sufficient corrosive processes occur to warrant design compensations, and hence minimize material problems encountered over the 25-30 year design life of the reactor plant. Considerations of wall thinning rates, particularly for thin walled structures such as fuel cladding or heat transfer tubing, changes in interstitial element contents for iron base alloys, changes in surface composition or microstructure which could lead to high wear rates or friction coefficients between contacting interfaces, and deposition of corrosion products in cold leg regions of the sodium system with resulting effects on radioactive maintenance, flow blockage, and heat transfer are described. 16 references. (auth)

## Research, Test, and Experimental Reactors

*Refer also to abstracts 11585, 13962, 13988, 13989, 13997, 13998, 14075, 14079, 14082, 14083, 14110–14113, 14182, 14189, and 14192.*

**14022** (AREAEE–193) TEMPERATURE MEASUREMENTS OF WWR REACTOR FUEL ELEMENTS. El-Fouly, M. F.; Zaki, G. M.; Mina, A. R. (Atomic Energy Establishment, Inshas (Egypt)). 1974. 28p. INIS.

A part of the WWR Reactor power increase program is measuring the cladding surface temperature of EK-10 fuel elements. The main purpose of these measurements is to collect data for the thermal behavior of the reactor core at different operating conditions. Two fuel elements were instrumented with 7 thermocouples at different axial positions and placed at different locations in the reactor core. Temperature measurements were made at steady state for natural and forced circulation conditions. The dependence of cladding and coolant temperatures on reactor power has been obtained. As part of this experiment the reactor power has been increased to 2.5 MW at the ordinary cooling flow rate and cladding surface temperatures were recorded. It has been also proved that operating the reactor at 3 MW is within the safety conditions. (auth)

**14023** (BNL-20627) BROOKHAVEN REACTOR EXPERIMENT CONTROL FACILITY, A DISTRIBUTED FUNCTION COMPUTER NETWORK. Dimmler, D. G.; Greenlaw, N.; Kelley, M. A.; Potter, D. W.; Rankowitz, S.; Stubblefield, F. W. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1975. 12p. (CONF-751116-15). Dep. NTIS $4.50.

From nuclear science symposium; San Francisco, California, USA (17 Nov 1975).

A computer network for real-time data acquisition, monitoring and control of a series of experiments at the Brookhaven High Flux Beam Reactor has been developed and has been set into routine operation. This reactor experiment control facility presently services nine neutron spectrometers and one x-ray diffractometer. Several additional experiment connections are in progress. The architecture of the facility is based on a distributed

function network concept. A statement of implementation and results is presented. (auth)

**14024** (CONF-750827--, pp 325-344) PROGRAM PLAN FOR DECONTAMINATION AND DECOMMISSIONING THE MATERIALS TESTING REACTOR AT THE INEL. Jones, T. F. (Aerojet Nuclear Corp., Idaho Falls, ID). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

A discussion is presented of a program plan developed for the dismantling of the Materials Testing Reactor located in the Testing Reactor Area (TRA) of the Idaho National Engineering Laboratory. Included are the scope of work, dismantling problems resulting from the nature of construction of the MTR, and a program plan for physically dismantling the reactor. (auth)

**14025** (CONF-750977-, pp 17.1-17.16) LIMITATIONS OF EBR-II ROD-DROP TESTS AND PROPOSED IMPROVEMENTS USING FREQUENCY-RESPONSE TESTING. Foltman, A. J. (Argonne National Lab., IL). 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

The rod-drop technique currently used at EBR-II and some of its limitations are described. A proposed technique to provide improved measurements that uses discrete binary input signals is discussed. (auth)

**14026** (COO-3409-4) TWENTIETH ANNUAL PROGRESS REPORT OF THE PENNSYLVANIA STATE UNIVERSITY BREAZEALE NUCLEAR REACTOR, JULY 1, 1974–JUNE 30, 1975. Totenbier, R. E. (ed.). (Pennsylvania State Univ., University Park (USA). Dept. of Nuclear Engineering). Jun 1975. Contract AT(11-1)-3409. 80p. Dep. NTIS $6.00.

Activities are described under the headings of personnel; administration; facility operation; education and training; radionuclear applications laboratory; facility research utilization; and theses, publications, and reports. (DG)

**14027** (DP-MS-75-68) SCHEDULING AND RECORDING OF REACTOR MAINTENANCE AND TESTING BY COMPUTER. Gray, P. L. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 14p. (CONF-751101-64). Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

The use of a computer program, Maintenance Information and Control (MIAC), at the Savannah River Laboratory (SRL) assists a small operating staff in maintaining three research reactors and a subcritical facility. The program schedules and defines preventive maintenance, schedules required periodic tests, logs repair and cost information, specifies custodial and service responsibilities, and provides equipment maintenance history, all with a minimum of record-keeping. (auth)

**14028** (GEAP-14002) FTR GRID-SPACED ASSEMBLY DESIGN BASIS REPORT. Kaplan, S.; Feerick, B. T.; Moron, J. V.; Allen, D. C. (General Electric Co., Sunnyvale, Calif. (USA). Breeder Reactor Dept.). May 1975. Contract AT(04-3)-893. vp. AT.

The Grid-Spaced Driver Assembly (GSDA) is being developed for use at LMFBR core design and operating conditions as an alternate fuel rod support system to the wire-wrap design. The projected benefits include a design alternative for extended life because of the grid's greater compliance, i.e., greater tolerance to differential planar swelling, and an LMFBR driver assembly that is reliable, safe, and economical. The GSDA design utilizing the straight-wave beam grid-spacer concept was evaluated in this report for irradiation in FTR. Three such GSDAs are being fabricated for irradiation in FTR. The design of these GSDAs is based on the experience gained from conducting the F9E and F9F grid spaced assemblies in EBR-II and a program of out-of-pile testing and development. The GSDA design and the associated design methods will be evaluated and improved based on a comparison of the predicted performance summarized in this report with the actual performance observed during the interim and post-irradiation examination. 43 references. (auth)

**14029** (HEDL-TME-75-93) INSTALLATION OF THE FFTF IN-VESSEL HANDLING MACHINE INTO A SODIUM ENVIRONMENT. Carver, J. R.; Teal, G. R.; Waldo, J. B. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Contract AT(45-1)-2170. Nov 1975. 37p. AT.

The FFTF in-vessel handling machine engineering model was successfully installed in the sodium/argon environment of the composite reactor component test activity. Since all of the components of the FFTF large component handling system were not available, special equipment and procedures were required to accomplish the installation. Highlighting the transfer was the successful use of a cylindrical plastic shroud, 42 feet long and 8.5 feet in diameter, to exclude air from the CRCTA vessel while the IVHM was lowered into position. (auth)

**14030** (HEDL-TME-75-99) BICM-1 INSTRUMENTED IRRADIATION OF BORON CARBIDE. Pitner, A. L. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Oct 1975. Contract AT(45-1)-2170. 65p. AT.

Eighteen boron carbide specimens were irradiated for 355 effective full power days in the EBR-II to maximum burnups of $82 \times 10^{20}$ captures/cm$^3$. Baseline specimens were patterned after FFTF reference boron carbide, and material variables of $^{10}B$ enrichment, pellet density, grain size, and stoichiometry were investigated in the test. Irradiation temperatures ranged from 1175$^0$F to 1570$^0$F. Each specimen was individually instrumented to measure temperature and helium release continuously during irradiation. Post-irradiation examination provided information on pellet integrity, swelling, tritium retention, and compatibility with stainless steel containment components. (auth)

**14031** (JAERI-M-5962) REMOVAL OF THE IN-PILE GAS LOOP TLG-1-50. Kitahara, T.; Yokoo, H.; Kaieda, K.; Toyoshima, N.; Fukushima, M. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 34p. (In Japanese). INIS.

The in-pile helium loop TLG-1-50 was removed from a horizontal hole of the JRR-2 reactor in the period of January to March 1974 with completion of the experiments. The loop had been utilized for development of the irradiation techniques and study on fission-product behavior. The following are described in detail: safety examination, procedure of the dismantling, disposal of the components dismantled, evaluation of the radiation exposure, and post-removal reactor check. Calculations of the induced activities in the in-pile tube and of the shielding effect of its container are presented. (auth)

**14032** (JAERI-M-6030) EFFECT OF THE HEATED LENGTH ON THE BURNOUT HEAT FLUX IN THE ROD-BUNDLE TEST SECTION. Yamazaki, Y.; Iguchi, T.; Niitsuma, Y.; Takano, K. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 26p. (In Japanese). INIS.

A series of burnout studies was previously performed on 3 – or 4 – rod bundles constituting the unit lattice of ATR fuel assemblies; the heated length of the rod bundles is 300 mm because of the power capacity. As the first in the new series of burnout studies with the power raised to 500 kW, the effects of heated length in the rod bundle test sections were studied. The test section consists of a 3-rod-bundle and a shroud tube. The outer diameter of the rod is 10 mm and the rod-to-rod gap and rod-to-shroud gap are 1.75 mm. Tests were made for the test section of heated lengths 300 mm, 600 mm or 900 mm respectively, at system pressure 10 ~ 40 kg/cm$^2$, water flow rate $(2 \sim 10) \times 10^6$ kg/m$^2$hr, and inlet subcooling 30 ~ 60°C. The burnout heat fluxes in 300 mm test section by a bridge-type detector are in good agreement with those in the previous study. Effect of the heated length on the burnout heat flux is minimal. (auth)

**14033** (JAERI-M-6031) BURNOUT HEAT FLUX OF NARROW-SPACED ROD BUNDLES. Effect of Flow Rate and Steam Quality. Yamazaki, Y.; Iguchi, T.; Niitsuma, Y. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 33p. (In Japanese). INIS.

In the designs of ATR fuel assemblies narrow rod-to-rod clearances and unsymmetric rod arrays are used. It is important how the factors influence burnout heat flux of the rod bundles. The effects were studied for 3- or 4-rod bundles previously. Capacity of the test facility made it impossible to observe the effects for various mass velocities at constant exit quality. A 500 kW preheater installed solved the problem. Burnout experiments to study the effects of rod clearance and spacers in wide quality ranges were thus carried out at constant mass flow rate. The test section is 3- or 4-rod bundle having rod-to-rod and rod-to-shroud clearances of 1.75, 2.5 and 4.0 mm respectively. The outer diameter of the rod is 10 mm and the heated length is 300 mm. Experiments were made at system pressure 10 kg/cm$^2$ abs., inlet velocity 0.5 ~ 3 m/s and inlet quality −5 ~ +30%. Burnout heat flux of the rod bundles is less than that of the tube of same diameter. Effect of the rod clearance is minimal for the high qualities. The spacers influence largely position of the high

temperature spot on the rods, but only little the burnout heat flux or rod bundles. (auth)

**14034** (LA-6016-SOP) TECHNICAL SPECIFICATIONS FOR THE PAJARITO SITE CRITICAL EXPERIMENTS FACILITY. Paxton, H. C. (Los Alamos Scientific Lab., N. Mex. (USA)). Jun 1975. Contract W-7405-ENG-36. 9p. Dep. NTIS $4.00.

This document is to satisfy the requirement for technical specifications spelled out in ERDA Manual Chapter 0540, "Safety of ERDA-Owned Reactors." Technical specifications are defined in Sec. 0540-048, and the requirement for them appears in Sec. 0540-015. The following technical specifications replace the document, "Operating Limits for the Los Alamos Critical Assembly Facility," revised May 27, 1971. (auth)

**14035** (ORNL-TM-5183) ABSOLUTE NEUTRON SPECTRUM EMERGING THROUGH THE LARGE BEAM COLLIMATOR FROM THE TSR-II REACTOR AT THE TOWER SHIELDING FACILITY. Maerker, R. E.; Muchenthaler, F. J. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 26p. AT.

The neutron spectral intensities in a 51-group structure together with the angular distributions in an 8-angle quadrature set are presented which describe the surface leakage from the hemispherical pressure vessel surrounding the TSR-II reactor at the Tower Shielding Facility. These data may be used as free-field source terms in the calculations of experiments performed using the large beam collimator, and were derived from many different measurements made at various positions in the beam that were used to normalize ANISN calculations of the pressure vessel leakage. (auth)

**14036** (ORNL-TM-5225) DETERMINATION OF THE NEUTRON ENERGY AND SPATIAL DISTRIBUTIONS OF THE NEUTRON BEAM FROM THE TSR-II IN THE LARGE BEAM SHIELD. Clifford, C. E.; Muckenthaler, F. J. (Oak Ridge National Lab., Tenn. (USA)). Jan 1976. Contract W-7405-eng-26. 50p. Dep. NTIS $5.50.

The TSR-II reactor of the ORNL Tower Shielding Facility has recently been relocated within a new, fixed shield. A principal feature of the new shield is a beam port of considerably larger area than that of its predecessor. The usable neutron flux has thereby been increased by a factor of approximately 200. The bare beam neutron spectrum behind the new shield has been experimentally determined over the energy range from 0.8 to 16 MeV. A high level of fission product gamma ray background prevented measurement of bare beam spectra below 0.8 MeV, however neutron spectra in the energy range from 8 keV to 1.4 MeV were obtained for two simple, calculable shielding configurations. Also measured in the present work were weighted integral flux distributions and fast neutron dose rates. (auth)

**14037** (ZFK-232) ROSSENDORF ASSEMBLY FOR CRITICAL EXPERIMENTS (RAKE2). Huettel, G.; Krause, H.; Matthes, W. (Zentralinstitut fuer Kernforschung, Rossendorf bei Dresden (German Democratic Republic)). Mar 1972. 21p. (In German). INIS.

RAKE is the third zero-power reactor of the Central Institute for Nuclear Research in Rossendorf. Together with a general representation of the plant a detailed description of the mechanical construction and of the control and safety system is given. A discussion about the possibilities to use the assembly for reactor physics investigations is included. (INIS)

**14038** HFBR TAILORED-BEAM FACILITY. Chrien, R. E. (Brookhaven National Lab., Upton, NY); Rimawi, K.; Wasson, O. A.; Greenwood, R. C. pp 341-345 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A flexible filtered neutron beam facility has been installed at the High Flux Beam Reactor at Brookhaven. The characteristic parameters of the various beam filters, iron/aluminum, lithium, and bismuth are given. Examples of the application of these beams to experiments on neutron capture gamma-rays are discussed. (auth)

**14039** FILTERED 2 keV BEAM AT THE NBS REACTOR. Schwartz, R. B. (National Bureau of Standards, Washington, DC); Schroder, I. G.; McGarry, E. D. pp 346-349 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Cenrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A scandium-titanium filter which views a manganese scatterer was installed in a through tube of the NBS reactor. This results in a pure 2 keV neutron beam, with only ≈3% of higher energy neutrons and 1 mR/hr gamma-ray background. (auth)

**14040** PRODUCTION AND USE OF QUASIMONOENERGETIC NEUTRON BEAMS AT THE R2 REACTOR, STUDSVIK. Albinsson, H.; Ryde, N. (Chalmers Inst. of Tech., Goteborg). pp 350-352 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A new facility is described which is under construction at the R2 reactor, Studsvik, and which will be used for the production of various neutron beams of energies in the range of 0.1 to 150 keV. The construction is based on both the resonance scattering technique with a scattering foil placed in a tangential beam tube in a position near the reactor core, and on the resonance window filter technique. (auth)

**14041** PLANS FOR AN INTENSE BEAM OF HIGHLY POLARIZED THERMAL NEUTRONS AT THE HFR IN PETTEN. Stecher-Rasmussen, F. (FOM-RCN Nuclear Structure Group, Petten, Netherlands). pp 718-721 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

A study has been made of the possibility to increase the flux of polarized thermal neutrons emerging from a focusing system of magnetized neutron mirrors placed at the High Flux Reactor in Petten. Two features are introduced, first the use of the thermal column as a neutron source, second a change of the geometry of the mirrors. Calculations indicate that a neutron-flux density of $9 \times 10^7$ $cm^{-2}s^{-1}$ can be expected from a mirror system placed at the thermal column. (2 figures) (auth)

**14042** ISOTOPIC ANALYSIS FACILITY USING NEUTRON CAPTURE. Bird, J. R. (Australian Atomic Energy Commission, Lucas Heights); Russell, L. H.; Bubb, I. F. pp 740-742 of Neutron Capture Gamma-Ray Spectroscopy. Petten, Netherlands; Reactor Centrum Nederland (1975).

From 2nd international symposium on nuclear capture gamma-ray spectroscopy; Petten, Netherlands (2 Sep 1974). See CONF-740920-.

Prompt gamma rays from capture of a thermal neutron beam in 10-100 g samples are detected with a Ge(Li) detector. Automated data analysis provides a versatile technique for determination of those elements with sufficiently high capture cross-sections and branching ratios. This method is illustrated by results for chlorine in wheat and minerals in ores. (3 figures) (auth)

**14043** UTILIZATION OF PEGASE FOR THE STUDY OF HTGCR AND LMFBR SAFETY PROBLEMS. Eckert, R.; Lurie, R.; Desandre, C.; Urlacher, C.; Marin, F.; Gouirand, J. M. (CEA Centre d'Etudes Nucleaires de Cadarache, 13-Saint-Paul-les-Durance (France). Service de la Pile Pegase). pp 174-176 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The association of independent loops, special irradiation facilities, purification and analysis circuits, are adapted to HTGCR or LMFBR fuel elements studies to improve their performance and safety. A large range of irradiation facilities allows testing several fuel types under severe irradiation conditions up to their destruction. A description of these tests is given. (FR)

**14044** CERTAIN QUESTIONS OF NUCLEAR RESEARCH REACTOR ECONOMICS. Zelenov, V. I.; Karpechko, S. G.; Nikiforov, A. D. At. Energ. (USSR); 39: No. 1, 9-11(Jul 1975). (In Russian).

The procedure for estimating the cost of experiments on a nuclear research reactor, assuming the distribution of fixed expenditures on a pile to be equally divided among all the experiments and variable costs proportional to the product of "work" surface of the experiment channel and volume-averaged neutron flux in it, is described. The concept of cost of neutrons in experiment equipment is introduced and the effect of certain indicators of pile utilization—average work capacity and capacity utilization coefficient—on the cost of neutrons is considered. (auth)

**14045** INSTALLATION, DEVELOPMENT, AND OPERATION OF THE PETTEN HIGH FLUX REACTOR. Swanenburg de Veije, R. J. (Stichting Reactor Centrum Nederland, Petten). Atoomenerg. Haar Toepass.; 17: No. 7-8, 157-169(Jul 1975). (In Dutch).

The Petten high flux reactor core is described in detail. It comprises aluminium clad fuel plates and water flow channels defining a 9 × 9 pattern containing 31 fuel assemblies and six cadmium control rods. The development of the core configuration is traced and improvements in the neutron flux shapes are outlined. Distribution of effort is quoted and shown by pie-chart diagrams for the aspects of national effort and technological features such as materials research, isotope production, reactor core physics, etc. Safety experiments have been conducted, especially to check the effect of loss of coolant. Details are given of isotope production. Nuclides which have been made include I-131, Hg-197, Hg-203, Cr-51, Au-198 and Tc-99m. (NL)

**14046** LOOP CHANNEL-CONVERTER FOR TESTING HIGHLY ENRICHED FUEL ELEMENTS IN A RESEARCH REACTOR. Bobkov, V. G.; Klimentov, V. B.; Kopchinskii, G. A.; Melnikov, M. V.; Nechiporuk, V. A. At. Energ. (USSR); 39: No. 1, 28-32(Jul 1975). (In Russian).

Neutron-physical characteristics of a model loop channel, in which a highly-enriched seven-pin cluster of fuel elements was surrounded by a 90%-enriched $UO_2$ screen, are presented. The loop apparatus makes it possible to increase the representatives of fast reactor fuel element tests in a research thermal reactor. In the model fuel element cluster ($UO_2$ 90%-enriched, fuel rod diameter—0.9 cm), the maximal energy release ratio was 1.21 for an optical screen thickness of 6.5, whereby half the fissions in the cluster assembly are due to neutrons having an energy of more than 10 keV. (auth)

## Production and Materials Testing and Processing Reactors

**14047** (DP-1390) CONFINEMENT OF AIRBORNE RADIOACTIVITY. Progress Report, January–December 1974. Dexter, A. H.; Evans, A. G.; Jones, L. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1974. Contract AT(07-2)-1. 56p. Dep. NTIS $5.50.

Several commercial activated carbons, marketed for iodine removal in reactor off-gas cleanup systems, were evaluated for iodine penetration at elevated temperatures (4 hr at 180°C), and the penetration data varied widely. Subsequent chemical analysis of the samples indicated a strong correlation between the atom ratio of iodine to potassium (I/K) in the carbon and the high-temperature performance data. Iodine penetration tests were also performed on several carbons in an intense gamma radiation field (greater than $10^7$ rads/hr). Test data show that carbons intentionally exposed to high concentrations of DOP aerosol performed as well as unexposed carbons. Studies of the rate of evaporation of elemental iodine from aqueous solutions indicated that significant quantities of $I_2$ might be expected to become airborne within a short period of time (5 hr) after release to open ponds. Addition of sodium thiosulfate to the solution substantially reduced the evaporative loss of iodine; however, the effects of high-intensity radiation fields on iodine-thiosulfate solutions remain to be evaluated. Small HEPA filters containing filter media of the type used in the Savannah River confinement system were exposed to reactor building air and a high-intensity radiation field. Following this exposure, they were tested for flow performance under simulated accident conditions. Radiation exposure slightly impaired the performance of new filters and improved the performance of service-aged filters. Service aging effects on filter performance were far more significant than radiation effects. (auth)

## Propulsion and Package Reactors

*Refer also to abstract 14114.*

**14048** (AI-AEC-12738) SNAP REACTOR AEROSPACE NUCLEAR SAFETY PROGRAM. Annual Report, GFY 1968. Determan, R. L. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Oct 1968. Contract AT(04-3)-701. 19p. Dep. NTIS $4.50.

Declassified 23 Oct 1975.

Techniques were developed for calculating the effects of Gd-155 addition to SNAP reactors. Gadolinium oxide was successfully added to nickel and rolled into foils 2 mils thick; it was demonstrated that these foils are compatible with the SNAPTRAN machine. An operating manual for the intrinsic subcriticality experiments using the SNAPTRAN machine was completed, and reviews with appropriate safety authorities were started. Test procedures for the experimental program were completed and approved, and checkout was begun. (auth)

**14049** (CNLM–283) PROGRESS REPORT FOR THE MONTH OF SEPTEMBER 1957. Strough, R. I. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 14 Oct 1957. 8p. Dep. NTIS $3.50.

Declassified 12 Jan 1976.

Progress in reactor engineering associated with aircraft propulsion reactors is briefly reported. (JWR)

**14050** (CNLM–519) LIQUID CYCLE AIRCRAFT REACTOR: DESIGN AND EVALUATION. Quarterly Progress Report. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 20 Jan 1958. Contract AT(11-1)-229. 49p. Dep. NTIS $4.00.

Declassified 12 Jan 1976.

Progress in the development of a liquid-cycle aircraft propulsion reactor is presented. (JWR)

**14051** (CNLM–626(Rev.)) LIQUID CYCLE AIRCRAFT REACTOR: DESIGN AND EVALUATION. Quarterly Progress Report. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 10 Mar 1958. Contract AT(11-1)-229. 50p. Dep. NTIS $4.00.

Declassified 12 Jan 1976.

Progress in the development of a liquid-cycle aircraft propulsion reactor is reported. (JWR)

**14052** (CNLM-749) PERFORMANCE GROUP PROGRESS REPORT, APRIL 1958. Andrews, N. D. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 6 May 1958. 5p. Dep. NTIS $3.50.

Declassified 12 Jan 1976.

Performance studies of proposed nuclear propulsion systems for the Princess airplane are presented. (JWR)

**14053** (CNLM–1304) PROPOSAL FOR AMENDMENT TO CONTRACT NOas 58-662-c COVERING ENGINEERING STUDIES AND DEVELOPMENT OF COMPONENTS FOR AIRCRAFT NUCLEAR PROPULSION SYSTEMS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 15 Dec 1958. 30p. Dep. NTIS $4.00.

Declassified 12 Jan 1976.

Information is presented concerning the development cost for the aircraft propulsion reactor, development of liquid metal-to-air radiation design, development of temperature sensors, and development of liquid metal pumps. (DCC)

**14054** (CNLM–1344) GIVING WORK CLASSES BY NUMBER AND DESCRIPTION. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 1964. 12p. Dep. NTIS $3.50.

Specific projects in the program for development of a nuclear aircraft engine are described. (JWR)

**14055** (CNLM–1613) BUDGET ESTIMATE, FY 1961. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 1961. 50p. Dep. NTIS $4.00.

Declassified 12 Jan 1976.

Budget estimates for the program for development of aircraft propulsion reactors are presented. (JWR)

**14056** (CNLM-5700) PROGRAM COST ESTIMATE FOR SNAP-50/SPUR, FISCAL YEARS, 1965-1966. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 20 May 1964. Contract AT(30-1)-2789. 48p. Dep. NTIS $4.00.

Declassified 12 Jan 1976.

**14057** (CNLM–5862) WEEKLY PROGRESS REPORT, AUGUST 24–28, 1964. Parks, G. U. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 1 Sep 1964. 4p. Dep. NTIS $3.50.

Declassified 9 Jan 1976.

Progress in the design and development of an aircraft propulsion reactor is briefly reported. (JWR)

**14058** (CNLM–5867) WEEKLY PROGRESS REPORT, AUGUST 31–SEPTEMBER 4, 1964. Parks, G. U. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 8 Sep 1964. 4p. Dep. NTIS $3.50.

Declassified 9 Jan 1976.

Progress in the design and development of an aircraft propulsion reactor is briefly reported. (JWR)

**14059** (CNLM–6170) BUDGET ESTIMATE FOR FISCAL YEAR 1967. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). 5 Apr 1965. Contract AT(30-1)-2789. 60p. Dep. NTIS $4.50.

Declassified 9 Jan 1976.

Budget estimates for the SNAP-50/SPUR program for F.Y. 1967 are presented. (JWR)

**14060** (DC-60-5-24) THRUST REQUIREMENTS FOR SUPERSONIC AIRPLANES. Thome, P. G.; Nicoll, H. E. (General Electric Co., Cincinnati, Ohio (USA). Aircraft Nuclear Propulsion Dept.). 28 Apr 1960. 46p. Dep. NTIS $5.00.

Declassified 13 Sep 1973.

The cruise and take-off thrust requirements of nuclear supersonic airplanes designed for Mach numbers of 1.5, 2, 2.5 and 3 are presented. The requirements are expressed as a function of power plant plus crew shield weight and flight altitude. The total weight of the nuclear propulsion system was varied from 140,000 pounds to 340,000 pounds and the flight altitude from 20,000 to 80,000 feet. In addition the thrust requirements of a nuclear version of the B-70 are given as a function of total nuclear propulsion system weight and flight Mach number. (auth)

**14061** (PWAC-183(Suppl.1)) POWERPLANT CHARACTERISTICS. (Pratt and Whitney Aircraft, Middletown, Conn. (USA)). [nd]. 5p. Dep. NTIS $3.50.

Declassified 12 Jan 1976.

Revised estimates of shield weight, reactor dose pattern, and reactor shield envelope for the lithium cooled WS-125 A powerplant are presented. (JWR)

# Reactor Safety and Environmental Aspects

*Refer also to abstracts 11949, 12029, 12032, 12039, 12057, 12442, and 14179.*

**14062** (AI-ERDA-13155) ANNUAL TECHNICAL PROGRESS REPORT NUCLEAR SAFETY CHARACTERIZATION OF SODIUM FIRES AND FAST REACTOR FISSION PRODUCTS, GOVERNMENT FISCAL YEAR 1975. (Atomics International Div., Canoga Park, Calif. (USA)). 15 Aug 1975. Contract AT(04-3)-824. 53p. Dep. NTIS $5.45.

Progress is reported in the areas of sodium jet dispersal tests, stationary sodium drop tests, SOMIX code development, buoyant bubble rise tests, aerosol leakage, fuel and fission product release from burning sodium, and heat-temperature properties of fuel mixture. (GD)

**14063** (ANCR-1207) TRANSIENT THREE-DIMENSIONAL THERMAL-HYDRAULIC ANALYSIS OF NUCLEAR REACTOR FUEL ROD ARRAYS: GENERAL EQUATIONS AND NUMERICAL SCHEME. Wnek, W. J.; Ramshaw, J. D.; Trapp, J. A.; Hughes, E. D.; Solbrig, C. W. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Nov 1975. Contract E(10-1)-1375. 47p. Dep. NTIS $5.45.

A mathematical model and a numerical solution scheme for thermal-hydraulic analysis of fuel rod arrays are given. The model alleviates the two major deficiencies associated with existing rod array analysis models, that of a correct transverse momentum equation and the capability of handling reversing and circulatory flows. Possible applications of the model include steady state and transient subchannel calculations as well as analysis of flows in heat exchangers, other engineering equipment, and porous media. (auth)

**14064** (ANCR-1235) EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1 TEST S-02-5 (BLOWDOWN HEAT TRANSFER TEST). (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.). Dec 1975. Contract E(10-1)-1375. 97p. Dep. NTIS $6.50.

Recorded test data are presented for Test S-02-5 of the Semiscale Mod-1 blowdown heat transfer test series. Test S-02-5 is one of several Semiscale Mod-1 experiments conducted to investigate the thermal and hydraulic phenomena accompanying a hypothesized loss-of-coolant accident in a water-cooled nuclear reactor system and to provide data for the assessment of the Loss-of-Fluid Test (LOFT) design basis. Test S-02-5 was conducted from an initial cold leg fluid temperature of 544°F and an initial pressure of 2,253 psia. A simulated double-ended offset shear cold leg break was used to investigate the system response to a depressurization transient with full core power (1.6 MW). An electrically heated core was used in the pressure vessel to simulate the effects of a nuclear core. System flow was set to achieve the full design core temperature differential of 66°F. The flow resistance of the intact loop was based on core area scaling. During system depressurization, core power was reduced from the initial level of 1.6 MW in such a manner as to simulate the surface heat flux response of the LOFT nuclear fuel rods until such time that departure from nucleate boiling occurs. (auth)

**14065** (ANCR-1237) EXPERIMENT DATA REPORT FOR SEMISCALE MOD-1, TEST S-02-7. Blowdown Heat Transfer Test. Crapo, H. S.; Jensen, M. F.; Sackett, K. E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nov 1975. Contract E(10-1)-1375. 134p. Dep. NTIS $5.45.

Recorded test data are presented for Test S-02-7 of the Semiscale Mod-1 blowdown heat transfer test series conducted to investigate the thermal and hydraulic phenomena accompanying an hypothesized loss-of-coolant accident (LOCA) in a water-cooled nuclear reactor system and to provide data for the assessment of the Loss-of-Fluid Test (LOFT) design basis. Test S-02-7 was conducted from an initial cold leg fluid temperature of 543°F and an initial pressure of 2,263 psia. A simulated double-ended offset shear cold leg break was used to investigate the system response to a depressurization transient with full design core power (1.6 MW). An electrically heated core was used in the pressure vessel to simulate the effects of a nuclear core with power set to provide a flat radial power profile. System flow was set to achieve the full design core temperature differential of 66°F. Blowdown to the pressure suppression system was accomplished without simulated emergency core cooling injection or pressure suppression system coolant spray. The uninterpreted data from Test S-02-7 are presented for future data analysis and test results reporting activities. The data, presented in the form of graphs in engineering units, have been analyzed only to the extent necessary to assure that they are reasonable and consistent. Also included as an appendix are selected data from a test identified as Test S-02-7C. This test was an initial attempt at Test S-02-7 in which an inadvertent power trip occurred at 2.3 seconds after rupture. Selected data comparisons of the results from Test S-02-7 and S-02-7C are presented to indicate the repeatability of system behavior. (auth)

**14066** (ANCR-1239) EVALUATION OF ECC RELATED PHENOMENA DURING SEMISCALE MOD-1 ISOTHERMAL TESTS. Hanson, D. J.; French, R. T.; Shaffer, C. J. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). Nov 1975. Contract E(10-1)-1375. 43p. Dep. NTIS $5.45.

Selected experimental data from tests performed during the Semiscale Mod-1 isothermal test series are analyzed. The analysis is confined to data that describe phenomena related to the injection of emergency core coolant (ECC). The analysis is directed at the ECC related phenomena in the intact loop cold leg, inlet annulus, downcomer, and lower plenum because, depending on injection location, some or all of these components will be in contact with the ECC as it flows to a position where cooling of an active core could result. Specifically, the condensation phenomena that occur in the intact loop cold leg, inlet annulus, and downcomer are analyzed along with downcomer heat transfer and counter-current flow phenomena to determine their effects on ECC delivery. The effectiveness of injecting ECC at various locations in the Semiscale Mod-1 system is evaluated. (auth)

**14067** (BMI-1941) EXPERIMENTAL STUDIES OF ECC DELIVERY IN A 1/15-SCALE TRANSPARENT VESSEL MODEL. Flanigan, L. J.; Cudnik, R. A.; Denning, R. S. (Battelle Columbus Labs., Ohio (USA)). Nov 1975. 89p. Dep. NTIS $6.00.

A description is presented of experimental studies in a 1/15-scale transparent vessel model of a 4-loop PWR, operated at approximately atmospheric pressure. The studies are being conducted to extend the understanding of steam-water interaction phenomena and of processes associated with a loss-of-coolant accident. (auth)

**14068** (BMI-X-662) AEROSOL BEHAVIOR MODELING FOR FAST REACTOR SAFETY: FY 1975 ANNUAL REPORT. Gieseke, J. A.; Reed, L. D. (Battelle Columbus Labs., Ohio (USA)). Oct 1975. Contract W-7405-eng-92. vp. Dep. NTIS $5.45.

Information is presented concerning the compilation of data for the analysis of aerosol behavior for fast reactor safety, HAARM-1 users' manual, improved particle size distribution representation, aerosol agglomerate behavior, radiation effects on aerosol behavior, and sensitivity analyses. 13 references (DCC)

**14069** (BMI-X-663) WORK PLAN: AEROSOL BEHAVIOR MODELLING FOR FAST REACTOR SAFETY. Reed, L. D.; Gieseke, J. A. (Battelle Columbus Labs., Ohio (USA)). Aug 1975. Contract W-7405-eng-92. 22p. Dep. NTIS $4.00.

A work plan for efforts on aerosol behavior modeling for fast reactor safety in the time period from July 1, 1974, through June 31, 1977, (FY 75, 76, and 77) is described. The overall goals of this study are to provide improvements in the capability to predict aerosol behavior in postulated fast reactor accident situations and verify this behavior to the extent possible by comparison with available experimental results. (auth)

**14070** (BMI-X-666) AEROSOL BEHAVIOR MODELING FOR FAST REACTOR SAFETY. Quarterly Progress Report, for July-

September 1975. Reed, L. D.; Gieseke, J. A. (Battelle Columbus Labs., Ohio (USA)). 30 Oct 1975. Contract W-7405-eng-92. 20p. Dep. NTIS $4.00.

Progress at Battelle has been made in three general areas. A sodium oxide aerosol generator has been designed and constructed for use with a Millikan cell apparatus in studying sodium oxide agglomerate characteristics. The experimental design, rationale, and procedure are discussed in detail. Also, further improvements have been made in the HAARM-1 aerosol behavior code and a second generation code, HAARM-2, has been developed. Furthermore, a preliminary comparison between the PARKISEKO-III code and the HAA-3B model has been performed. Results for a particular case are discussed. (auth)

**14071** (BNL-20594) PRELIMINARY ASSESSMENT OF A HYPOTHETICAL NUCLEAR ENERGY CENTER IN NEW JERSEY: EXECUTIVE SUMMARY. (Brookhaven National Lab., Upton, N. Y. (USA)). Nov 1975. Contract E(30-1)-16. 20p. Dep. NTIS $6.50.

Site selection aspects are summarized for a nuclear energy center in New Jersey. This analysis, which was intended to be representative of coastal locations in general, included consideration of energy demand projections, power transmission, organizational issues, siting constraints, land use issues, environmental issues, taxation, and institutional and political issues. Recommendations are made for follow-on studies. (DG)

**14072** (BNL-50457) NALAP: AN LMFBR SYSTEM TRANSIENT CODE. Martin, B. A.; Agrawal, A. K.; Albright, D. C.; Epel, L. G.; Maise, G. (Brookhaven National Lab., Upton, N. Y. (USA)). Jul 1975. Contract E(30-1)-16. 149p. Dep. NTIS $8.75.

NALAP is a LMFBR system transient code. This code, adapted from the light water reactor transient code RELAP 3B, simulates thermal-hydraulic response of sodium cooled fast breeder reactors when subjected to postulated accidents such as a massive pipe break as well as a variety of other upset conditions that do not disrupt the system geometry. Various components of the plant are represented by control volumes. These control volumes are connected by junctions some of which may be leak or fill junctions. The fluid flow equations are modeled as compressible, single-stream flow with momentum flux in one dimension. The transient response is computed by integrating the thermal-hydraulic conservation equations from user-initialized operating conditions by an implicit numerical scheme. Point kinetics approximation is used to represent the time dependent heat generation in the reactor core. (auth)

**14073** (BNWL-1924-1) CORE THERMAL MODEL DEVELOPMENT AND EXPERIMENTS. Progress Report, 1 July 1974-31 December 1974. Rowe, D. S. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. 61p. Dep. NTIS $4.00.

Analytical and experimental studies are being performed at the Pacific Northwest Laboratory to improve methods of thermal-hydraulic analysis for reactor cores. The work is primarily concerned with developing computational methods that can consider multidimensional two-phase hydrodynamic phenomena in reactor cores during postulated accidents. The basic approach being taken in the analytical part of this program is to adapt the subchannel analysis concept to analysis of a nuclear core. This is being done by representing the core as a matrix of control volumes. Transport equations are written for two-phase flow, and are then solved by a digital computer. This provides a multidimensional representation of the core from which it may be possible to define simpler analysis methods: i.e., define the minimum amount of detail required for core thermal analysis. The experimental part of this program is concerned with validating the computational model. Experiments are presently concerned with flow distributions in rod bundles containing flow blockages and with the evaluation of laser-Doppler techniques to measure two-phase hydrodynamic phenomena. Major efforts have been made to improve the computational capability of the COBRA code for reactor safety analysis; compare the code with experimental data; evaluate the code for core analysis; and experimentally measure velocity in rod bundles containing flow blockage. (auth)

**14074** (CEA-CONF-3109) DUST FILTER TESTING. Dupoux, J. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. de Protection). 1975. 33p. (CONF-750573-1). Dep. NTIS (US Sales Only) $4.75.

From international fair; Teheran, Iran (5 May 1975).

The construction and application of dust filters for use in industrial units such as nuclear power plants for the trapping of radioactive effluents are discussed. Sampling and testing procedures are mentioned. (ERB)

**14075** (CENPD-107(Amend. 1)(Suppl. 1)) ATWS MODEL MODIFICATIONS TO CESEC. Earles, D. R. (Combustion Engineering, Inc., Windsor, Conn. (USA)). Nov 1975. vp. Combustion Engineering, Inc., Windson, CT.

This amendment contains descriptions of significant improvements made to the CESEC (Combustion Engineering NSSS Digital Simulation Code) thermal-hydraulic models of the reactor coolant system including the pressurizer in order to allow analysis of anticipated operational occurrences without reactor scram (ATWS). It also contains descriptions of the CESEC models of the pressurizer instrumentation and components including pressurizer level measurement, sprays, heaters, and relief and safety valves as well as descriptions of the CESEC models of various RCS components and phenomena including the charging-letdown system, safety injection system, reactor main circulating pumps, surge line pressure drop, and primary system leak flows. These descriptions supplement information given in C-E Topical Report CENPD-107. The amendment also contains descriptions of the ancillary subroutines used in CESEC to calculate the steam generator secondary level during ATWS events. (auth)

**14076** (CENPD-168(Suppl.1)) DESIGN BASIS PIPE BREAKS FOR THE COMBUSTION ENGINEERING TWO LOOP REACTOR COOLANT SYSTEM. (Combustion Engineering, Inc., Windsor, CT. (USA)). Nov 1975. 19p. Combustion Engineering, Inc., Windsor, CT.

Supplementary information is presented on the calculational methods, assumptions, and criteria employed by Combustion Engineering in the analysis of the design basis pipe rupture accident. (DG)

**14077** (CONF-750607-30) USE OF VERTICAL SLIP FLOW AND FLOODING MODELS IN LOCA ANALYSIS. Fischer, S. R. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. Contract AT(10-1)-1375. 4p. Dep. NTIS $4.50.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

Vertical slip flow and flooding models, which have been incorporated in a version of the RELAP4 computer code by Aerojet Nuclear Company have led to significant improvements in modeling nuclear reactor coolant system phenomena during postulated large and small break loss-of-coolant accidents. The vertical slip flow model computes the separated fluid component velocities and directions at vertical flow junctions. Use of the slip model allows the energy transfer between volumes to be based on individual liquid and vapor component flows rather than on the net junction flow. Continuity and momentum equations are unaffected by the addition of slip. The vertical flow slip model logic is based on the assumption that gravity forces dominate causing slip between phases. 7 references (auth)

**14078** (CONF-750827--, pp 83-118) ELK RIVER REACTOR DISMANTLING. Davis, B. J. (Chicago Operations Office, Argonne, IL). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The dismantling program was carried out in three overlapping phases: the planning phase which included the preliminary planning and selection of the dismantling approach, the dismantling phase which included all work performed to remove the reactor facility and restore the site to its pre-reactor condition, and the closeout phase which included the final site survey and efforts necessary to terminate the AEC license and contract. Of particular interest was the use of a remotely operated plasma cutting torch to section the pressure vessel internals, the pressure vessel and the outer thermal shield, the use of explosives in removal of the biological shield and the method of establishment of the criteria for material disposal. (auth)

**14079** (CONF-750827--, pp 119-137) PROGRAM PLAN FOR REMOVAL OF THE MATERIALS TEST REACTOR OVERHEAD WORKING RESERVOIR. Lunis, B. C. (Aerojet Nuclear Co., Idaho Falls, ID). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The salient features are described of the removal of a contaminated facility, the Materials Test Reactor (MTR) Overhead Working Reservoir (OWR) from the Test Reactor Area (TRA) to the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering Laboratory (INEL). The 125 ton OWR was an overhead 160,000 gallon capacity tank approximately 193 feet

high which supplied cooling water to the MTR. Radiation at ground level beneath the tank was 5 mR/hr and approximately 800 mR/hr at the exterior surface of the tank. Sources ranging from 3 R/hr to in excess of 500 R/hr existed within the tank. The tank interior was contaminated with uranium, plutonium, and miscellaneous fission products. The OWR was lowered to ground level with the use of explosive cutters. Dismantling, decontamination, and disposal was performed by Aerojet Nuclear Company (ANC) maintenance forces. (auth)

**14080** (CONF-750827--, pp 139-151) DECONTAMINATION AND DISPOSITION OF HALLAM AND PIQUA REACTORS. Heine, W. F.; Ureda, B. F. (Atomics International, Canoga Park, CA). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The Hallam Nuclear Power Facility, a sodium cooled, graphite moderated, 256 Mw(t) power reactor, went critical in 1962, was shut down as a result of moderator problems in 1964, and was decommissioned in 1969. The Piqua Nuclear Power Facility, an organic cooled, 45 Mw(t) power reactor went critical in 1963, was shut down in 1966 because of coolant problems, and was decommissioned in 1969. Fuel, coolant, and support systems of both reactors were removed from the site. The reactor vessels are entombed at their sites. Remaining systems at Hallam were sealed in the underground vaults and were then covered with six feet of earth. The Piqua vessel is sealed in the concrete reactor containment building. The state of Nebraska is responsible for monitoring $3 \times 10^5$ curies in 1969. The Piqua site was purchased by the U. S. Government and then leased to the City of Piqua. The remaining radioactivity at Piqua was $2.6 \times 10^5$ curies. (auth)

**14081** (CONF-750827--, pp 253-274) DECONTAMINATION AND DECOMMISSIONING EXPERIENCE AT EXPERIMENTAL BREEDER REACTOR NO. 1. Kendall, E. W. (Aerojet Nuclear Corp., Idaho Falls, ID). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

A description is presented of the experience obtained from decontamination and decommissioning of the Experimental Breeder Reactor No. 1 located at the Idaho Nuclear Engineering Laboratory, Scottsville, Idaho. Included are the planning, preparation, and operations associated with the removal and processing of radioactively contaminated sodium-potassium eutectic alloy (NaK) and decontamination and decommissioning of the facility. (auth)

**14082** (CONF-750827--, pp 417-438) PREPARATIONS FOR DECONTAMINATION AND DISPOSITION OF THE SODIUM REACTOR EXPERIMENT (SRE) AND OTHER ERDA FACILITIES AT AI. Heine, W. F.; Graves, A. W. (Atomics International, Canoga Park, CA). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

The program plan for the decontamination and disposition of facilities at the Sodium Reactor Experiment and other ERDA-owned, AI-operated, radioactive facilities is described. The program objective along with a description of each of the subject facilities is presented. A description of the organizational structure within supporting the program is given. The elements of planning required to prepare for the task are detailed, including the requirements for cost and schedule control. Progress to date and the future plans are presented. The available technology utilized in the program is described. (auth)

**14083** (CONF-750827--, pp 439-461) DECOMMISSIONING PLAN FOR THE HEAVY WATER COMPONENTS TEST REACTOR. Field, F. R. (E. I. du Pont de Nemours and Co., Aiken, SC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

Three alternatives to decommission the Heavy Water Components Test Reactor (HWCTR) have been analyzed. The major elements of the alternatives are shown. No final choice has been made between alternatives, and all are feasible. Protective confinement is advantageous as long as current activities onsite require limited access by the general public, and because excellent confinement of the residual activity ($2.3 \times 10^4$ curies) is provided by in situ dry storage as the radiation from $^{60}Co$ diminishes. Entombment provides the most-secure confinement of the activity at some increased cost; in 35 years, the activity will decay to $2 \times 10^3$ curies and consist primarily of $^{63}Ni$. Dismantling HWCTR has no apparent advantages, other than a demonstration at the Savannah River site, because of the long-term commitment to safeguarding radioactive material; the relative cost is high. Selection of a plan for decommissioning will depend on criteria that are presently being formulated within ERDA and other regulatory bodies. (auth)

**14084** (CONF-751157-1) STATUS OF ACCIDENT ANALYSIS FOR FAST BREEDER REACTORS. Hummel, H. H. (Argonne National Lab., Ill. (USA)). Nov 1975. 23p. Dep. NTIS $4.50.

From 2nd annual post-accident heat removal info exchange meeting; Albuquerque, New Mexico, USA (13 Nov 1975).

There are still considerable deficiencies in computational tools available even for following accidents to initial disassembly. Present indications are that such a disassembly will be mild, without much sensitivity of this result to modeling assumptions, but the LOF-driven TOP requires better analysis. It is not possible at present to follow the course of an accident mechanistically beyond a first disassembly. Plugging and recriticality are possibilities, but so far do not appear likely to lead to a substantial increase in accident severity. It seems unlikely that the destructive work in an HCDA will be large enough to cause difficulties in containment. However, complete melting of the core material is a desirable assumption for PAHR analysis. It is not possible at present to predict what the relative upward and downward ejection of core material will be. (auth)

**14085** (ERDA-69) ENVIRONMENTAL IMPACT OF ELECTRICAL POWER GENERATION: NUCLEAR AND FOSSIL. (Pennsylvania Dept. of Education, Harrisburg (USA)). 1975. Contract AT(40-2)-4167. 240p. Dep. NTIS $8.00.

The increasing need for electrical power, and current and proposed methods for meeting this need are examined. Expansion of electrical generating capacity in the immediate future will be limited to nuclear power plants or fossil-fueled plants. Basic ecology and wastes from nuclear and fossil-fueled plants are discussed. Health effects are analyzed. The factors that must be taken into consideration when choosing the site for a new power plant are presented. Energy conservation and a summary of environmental effects are included. (auth)

**14086** (ERU-5309e) SECOND SPECIALIST MEETING ON SODIUM/FUEL INTERACTION IN FAST REACTORS, ISPRA, ITALY, 21-23 NOVEMBER 1973. Randles, J. (comp. and ed.). (Commission of the European Communities, Luxembourg). 1973. 602p. (CONF-731126-). EUR B. Fr. 1.500.

Each of the twenty-four papers presented has been separately indexed and abstracted. Abstracts of three papers appeared in previous issues of NSA. (DG)

*For abstracts of individual papers see: 11916 and 14087-14106.*

**14087** (EUR-5309e, pp vp Paper SNI 2/2) SOME OBSERVATIONS ON SODIUM-FUEL INTERACTIONS AFTER IRRADIATION OF SINGLE PINS UNDER LOSS OF COOLING CONDITIONS. Kwast, H. (Reactor Centrum Nederland, Petten). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

Irradiations are described of single fuel pins in a sodium environment under loss of cooling conditions. Eight experiments have been performed with non pre-irradiated fuel pins. Two of these pins were pre-pressurized. Failure of the non pre-pressurized pins occurred after significant bulging mainly in the lower half of the fuel pins. Fuel ejection, which happened quite slowly, was preceded by sodium expulsion from the annulus, so direct fuel-sodium interaction did not take place. Even more important was that also during sodium reentry a violent fuel-sodium interaction did not take place. Preliminary results of experiments with pre-pressurized fuel pins revealed that gas blanketing after pin failure under loss of cooling conditions can be rapidly followed by molten fuel ejection, however without causing measurable pressure pulses. (auth)

**14088** (EUR-5309e, pp vp Paper SNI 2/3) FUEL/COOLANT INTERACTIONS: SMALL SCALE EXPERIMENTS AND THEORY. Buchanan, D. J.; Dullforce, T. A. (Culham Lab., Abingdon, Eng.). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

Some recent experimental and theoretical work is reviewed. It is shown how many of the experimental results can be explained in terms of a recently proposed model. Further consequences of the model are also investigated and it is suggested that there exists a threshold value for the external pressure above which the interaction does not occur. (auth)

**14089** (EUR–5309e, pp vp Paper SNI 2/4) PROPAGATION IN THERMAL EXPLOSIONS. Board, S. J.; Hall, R. W. (Central Electricity Generating Board, Berkeley, Eng.). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

The results of several small-scale experiments demonstrate that spatial propagation (autocatalysis) can occur in thermal explosions. The results also suggest that the observed explosions are primarily due to fragmentation rather than superheat. It is shown that propagating fragmentation or mixing can occur through self-driven blanket collapse. At least some of the mixing may be due to the penetration of coolant jets formed by the collapse of vapor domes in the blanket. In a continuously propagating explosion, however, Taylor and Kelvin-Helmholtz induced mixing due to the motion of the interaction region could become the dominant process. There is some evidence that the propagation velocity is associated with sonic choking in the 3-phase interaction region. (auth)

**14090** (EUR–5309e, pp vp Paper SNI 2/5) KARLSRUHE VARIABLE MASS MODEL FOR THE DESCRIPTION OF THE FUEL/COOLANT INTERACTION. Caldarola, L.; Koutsouvelis, G. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

A model for the fuel-coolant interaction is derived in which the fuel and coolant masses participating in the reaction are not constant but functions of the time, and the fuel particles do not have the same radius, but are characterized by a "lognormal" distribution of the radius. The basic equations governing the interaction are given along with some numerical evaluations. It is shown that the hypothesis of a finite time for fragmentation and mixing greatly reduces the peak pressure. The effect of the lognormal distribution is an increase in the peak pressure. (auth)

**14091** (EUR-5309e, pp vp Paper SNI 2/6) EVALUATION OF CONSERVATISM IN ANALYSIS OF FUEL–COOLANT INTERACTION. Reynolds, A. B. (Univ. of Virginia, Charlottesville); Erdman, C. A.; Garner, P. L.; Haas, P. M.; Allen, C. L. 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra–Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

Two general approaches have evolved in the analysis of FCI. The first has been to assume that a large FCI can occur and then to estimate its consequences. The second approach has been to attempt to gain a basic understanding of the fragmentation and heat-transfer processes and thereby to determine whether a large FCI is a real possibility. The reported absence of energetic FCIs when fuel enters sodium, both in dropping experiments and in TREAT tests, has led some to contend that a large FCI may be impossible. The interpretations of these test results and their applicability to large-scale accidents, however, are still subject to question. Although further parametric analysis of FCI is definitely needed, it appears at this time that improved, more realistic models will result in reduced estimates of the mechanical work. It is not yet clear that appropriately conservative estimates will be low enough to change dramatically the nature of the containment picture, even after all model improvements are included. Hopefully results of investigations into the basic FCI phenomena will provide clear definitive evidence that conditions leading to a very energetic FCI cannot occur. It is apparent that for the present both approaches must continue to be pursued. (auth)

**14092** (EUR–5309e, pp vp Paper SNI 2/7) CALCULATION OF THE CONSEQUENCES OF SODIUM/FUEL INTERACTIONS WITH ALLOWANCE FOR TEMPERATURE GRADIENTS IN THE SODIUM. Jacobs, H. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

A description of the BRENDY code is presented together with an outlook on its further development. The code is applied to study the effect of various assumptions used in sodium-fuel interaction codes in connection with the following considerations: sodium thermal conductivity, heat transfer during phase B, fuel latent heat of fusion, decoupled heat transfer calculations, and incompressible sodium slug. (auth)

**14093** (EUR–5309e, pp vp Paper SNI 2/10) EXPERIMENTAL-THEORETICAL INVESTIGATION OF THE THERMAL EXPLOSION. Zyszkowski, W. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

Interactions between single drops of molten metal and water were studied. The resulting thermal explosions were filmed and a hypothesis was proposed to account for the observed phenomena. (DG)

**14094** (EUR–5309e, pp vp Paper SNI 2/11) LARGE SCALE FCI EXPERIMENTS IN SUBASSEMBLY GEOMETRY: TEST FACILITY AND MODEL EXPERIMENTS. Beutel, H.; Gast, K. (Kernforschungszentrum, Karlsruhe, Ger.). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

Local cooling disturbances or fuel failures originating in a fuel subassembly of a LMFBR core can eventually lead to bulk sodium boiling and, hence, to fuel melting in this subassembly, unless the reactor is shut down in time. Molten fuel may violently interact with sodium (FCI) in a vapour explosion and thereby cause mechanical damage to the surrounding core structure. An extensive experimental and theoretical program is described which consists of investigations of the more important phenomena preceding fuel melting and the development of special instruments for early detection of these phenomena. This effort is expected to yield the evidence that fuel melting as a necessary condition for a vapour explosion is a very unlikely event or can be made so by introduction of an early fault detection system. A complementary program is being conducted in parallel with the objective to demonstrate that the maximum deformation of the core structure which could result from a hypothetical FCI in a single subassembly would be tolerable from the safety point of view. Specifically, it is to be shown that such deformations would neither initiate a nuclear excursion nor render the shut-off system inoperable. Towards this goal, it is essential to establish a "realistic" upper bound of pressure-time histories produced by a FCI in a single subassembly. (auth)

**14095** (EUR–5309e, pp vp Paper SNI 2/12) PROCESS OF THERMAL INTERACTION BETWEEN MOLTEN FUEL AND COOLANT. Grossgut, W.; Kottowski, H. M.; Holtbecker, H.; Randles, J. (EURATOM, Ispra, Italy). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

An analysis is presented of the thermal interaction process and the mechanism of fragmentation and energy release as a function of time. (auth)

**14096** (EUR–5309e, pp vp Paper SNI 2/13) THERMAL INTERACTION EXPERIMENTS IN A CHANNEL GEOMETRY USING $Al_2O_3$ AND Na. Lazarrus, J.; Navarre, J. P.; Kottowski, H. M. (EURATOM, Ispra, Italy). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

LMFBR fuel-coolant interaction studies employing molten aluminum oxide and sodium are described. Results are presented and discussed. (DG)

**14097** (EUR–5309e, pp vp Paper SNI 2/14) STUDY ON SODIUM/FUEL INTERACTION AND ITS SIMULATION WITH OTHER TRANSIENT ENERGY TRANSFER PROCESSES IN WATER. Wahba, A. B. (Technische Univ., Munich). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

Based on publications on in-pile experiments it is shown that the first phase of molten fuel-sodium interaction is always accompanied by the formation of pressure waves. It is shown that the maximum pressure attained by the compressed liquid sodium near the reaction zone is determined from the Hugoniot

Equations. The difference in thermodynamic behavior between sodium and water during the phase of acoustic loading is demonstrated by some experimental results on a fast energy transfer process in water, where the physical processes accompanying the reflection and superposition of pressure waves are visualized. From the experimental results conclusions on some drawbacks concerning the use of water instead of sodium for simulating accidents involving the whole core of a fast breeder reactor are drawn. (auth)

**14098** (EUR-5309e, pp vp Paper SNI 2/15) RESULTS OF THERMAL INTERACTION TESTS FOR VARIOUS MATERIALS PERFORMED IN THE ISPRA TANK FACILITY. Fasoli-Stella, P.; Holtbecker, H.; Jorzik, E.; Schlittenhardt, P.; Thoma, U. (EURATOM, Ispra, Italy). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

A description is presented of experimental facilities and methods used in studies of fuel-coolant interactions. Data are presented on the interaction of sodium with molten uranium dioxide and molten fuel can materials. (DG)

**14099** (EUR-5309e, pp vp Paper SNI 2/16) RECENT JEF AND CORECT I SODIUM/FUEL INTERACTIONS RESULTS. Amblard, M.; Costa, J.; Syrmalenios, P. (CEN, Grenoble, France). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

The results of the sodium/fuel interactions obtained on the devices JEF (interaction of 7g of molten $UO_2$ with sodium at 400°C) and CORECT I (interaction of 3.2 kg of molten $UO_2$ with 300 g of sodium at 400°C) and their analysis with the CORFOU code are presented. (auth)

**14100** (EUR-5309e, pp vp Paper SNI 2/19) $UO_2$/Na INTERACTIONS: RECENT IN- AND OUT-OF-PILE EXPERIMENTS IN THE U.S. AND THEIR INTERPRETATION FOR FAST REACTOR SAFETY ANALYSIS. Speis, T. P. (Atomic Energy Commission, Washington, DC); Fauske, H. K. 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra-Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

A brief summary is presented of studies related to LMFBR fuel-coolant interactions. Included are TREAT and EBR-II in core tests and laboratory experimental studies of interactions with sodium and molten uranium dioxide. (DG)

**14101** (EUR-5309e, pp vp Paper SNI 2/20) REVIEW OF THE CREST COMPARISON OF SODIUM/FUEL INTERACTION COMPUTATIONS COVERING SEVEN METHODS. Potter, R.; Jakeman, D. (Atomic Energy Establishment, Winfrith, Eng.). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

Pressure transients calculated for a well-defined fuel-coolant interaction test case are compared. The seven different methods of calculation employed are briefly discussed. (DG)

**14102** (EUR-5309e, pp vp Paper SNI 2/21) OUT-OF-PILE EXPERIMENTS RELATED TO SODIUM-FUEL INTERACTION PERFORMED AT CNEN (USTS/N). Martini, M.; Crisafulli, N.; Falzetti, L.; Federico, A.; Pezzilli, M. (CNEN, Rome). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

Descriptions are presented of sodium-fuel interaction experiments employing direct Joule heating of uranium dioxide, feasibility experiments on x-ray cinematography for sodium-fuel interactions, and preliminary experiments on clad failure modes. (DG)

**14103** (EUR-5309e, pp vp Paper SNI 2/23) FUS-PEC 2 CODE AND SOME THEORETICAL REMARKS ON FUEL-SODIUM INTERACTION. Biasi, L. (ARS S.p.A., Milan); Clerici, G.C.; De Cecco, L.; Scarano, G. 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

The FUS-PEC 2 Code for the study of the fuel-sodium interaction is based on a model consisting of two phases. In the first phase, a conduction heat transfer from fuel to liquid coolant is considered. Since the coolant is heated quite rapidly by the fuel, the pressure increases in the interaction zone, which expands against the constraint given by the surrounding coolant. Then pressure decreases until the saturation value is reached. At this point the vaporization phase begins. The heat is now transferred from fuel to a two-phase mixture which is in thermodynamic equilibrium. The main features of FUS-PEC 2 Code are listed and compared with features of other codes, and some theoretical remarks on the fuel-sodium interaction are made. (auth)

**14104** (EUR-5309e, pp vp Paper SNI 2/24) CONSISTENT BOILING MODEL FOR FRAGMENTATION IN MILD THERMAL INTERACTIONS: BOUNDARY CONDITIONS. Schins, H. (EURATOM-CCR, Ispra, Italy). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

A mild thermal interaction occurs when crust formation and complete solidification of fuel takes place after fragmentation, i.e., when no entrapment is possible. In this quenching process, the hot fuel provokes one of the three possible boiling modes (nucleate, transition, or film boiling mode) in the adherent coolant layer. In order to predict the boiling mode, the boiling curve of the coolant must be considered. In this boiling curve the temperature of the heater surface must be substituted by the fuel-coolant liquid-liquid contact temperature. Natural fragmentation in thermal interactions will occur if the fuel is still molten when the contact temperature is in the transition boiling zone. In the consistent boiling model this fragmentation is the consequence of the following five transients: 1) direct liquid-liquid contact which causes a rapid temperature increase in the adherent coolant layer; 2) incipience of transition boiling which imparts a shock to the mass of the fuel because of the film patches; 3) cavitating collapse of these films when their meniscus temperatures have dropped below coolant saturation temperature; 4) entrainment of coolant in the fuel in those patches where there was film boiling; 5) fuel fragmentation caused by explosive vaporization of the entrained droplets. Use of the boiling curve in the proposed manner, which means use of the quenching curve, allows for obtaining the necessary boundary conditions for mathematical evaluations. (auth)

**14105** (EUR-5309e, pp vp Paper SNI 2/25) PROGRESS REPORT ON THE MOLTEN $UO_2$ DROP EXPERIMENT. Mizuta, H.; Hirabayashi, F.; Yokozawa, N.; Fukushima, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokai). 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

A series of 30 experiments was performed to examine the fragmentation characteristics of sodium-fuel interaction by dropping molten $UO_2$ into sodium. Annular $UO_2$ pellets were heated by the center line heating of tungsten rod, and the molten $UO_2$ droplets fell into the sodium tank. The fragmentations of the droplets on the surface of liquid sodium were photographed with high speed camera at 500-2000 pictures/sec. The pressure and temperature of sodium tank were measured. The particle characteristics of the $UO_2$ residue was examined on the particle size distribution, the particle surface condition, and the grain characteristic of the particles for the fragmentation mechanism. The examination indicates that the $UO_2$ particles can be assumed to be spherical and to have the log-normal distribution function. (auth)

**14106** (EUR-5309e, pp vp Paper SNI 2/26) ANALYSIS OF FUEL-SODIUM INTERACTION IN A FAST BREEDER REACTOR. Tezuka, M. (Nippon Atomic Industry Group Co., Kawasaki, Japan); Suzuki, K.; Sasanuma, K.; Nagasima, K.; Kawaguchi, O. 1973.

From 2nd specialist meeting on sodium fuel interaction in fast reactors; Ispra - Varese, Italy (21 Nov 1973).

In second specialist meeting on sodium/fuel interaction in fast reactors.

The SUGAR code has been developed to evaluate the molten fuel-sodium interaction in a fast breeder reactor. The code computes thermohydrodynamic behavior by heat transfer from fuel to sodium and dynamic deformation of reactor structures simultaneously. It was applied to evaluate a local fuel melting accident in a fuel assembly and a core disassembly accident for the 300 MW(e) Monju reactor. The analytical methods of the code are discussed. Calculations show that mass of fuel interacted with sodium, ratio of fuel mass to sodium mass, fuel particle size, heat transfer coefficient from fuel to sodium, and core structural features have great effect on pressure amplitude and deformation of reactor structures. (auth)

**14107** (GA-A-13672) GCR SAFETY PROGRAM QUARTERLY PROGRESS REPORT FOR THE PERIOD ENDING 30 SEPTEMBER

1975. (General Atomic Co., San Diego, Calif. (USA)). 31 Oct 1975. Contract E(04-3)-167. vp. Dep. NTIS $5.45.

The program covers development of safety and safety-related studies to better understand and more accurately define safety characteristics and safety margins of GCRs under postulated accident conditions. The work reported here includes core seismic studies, high-temperature gas-cooled reactor (HTGR) accident initiation and progression analysis, the setting up of a reliability data bank, safety liaison with RRD-selected contractors, and safety research on core-released radioactivity, secondary containment gas flammability, and containment atmosphere response during postulated accident situations. (auth)

**14108** (GEAP-13317-11) BWR BLOWDOWN HEAT TRANSFER. Eleventh Quarterly Progress Report, January 1–March 31, 1975. (General Electric Co., San Jose, Calif. (USA)). Apr 1975. Contract AT(04-3)-189. 143p. Dep. NTIS $6.00.

Evaluation of data from the first 49-rod bundle has been completed. Data from four blowdown heat transfer (BDHT) tests including NRC Standard Problem No. 4 are reported. The evaluation of independent parameter variations is presented. A measurement uncertainty analysis has been completed and the results are presented. Testing with the second 49-rod bundle has been initiated. (auth)

**14109** (GERRSR-3) RESEARCH REPORTS (ANNUAL REPORTS). State: End of 1974. (Institut fuer Reaktorsicherheit der Technischen Ueberwachungs-Vereine e.V., Koeln (F.R. Germany)). May 1975. Translation of IRS-F-24. 529p. Dep. NTIS $13.00.

Work performed under United States Nuclear Regulatory Commission--Light Water Reactor Safety Technical Exchange Program.

The scope, objectives, and status as of the end of 1974 are presented for reactor safety research projects in the German Federal Republic. The brief summaries are arranged according to project numbers and encompass essentially all aspects of concern in the safety of water cooled reactors. (HDR)

**14110** (HEDL-SA-764) ACCURACY OF COARSE MESH, THREE-DIMENSIONAL CALCULATIONS FOR QUASI-STATIC FAST REACTOR TRANSIENT ANALYSIS. Nelson, J. V.; Hardie, R. W. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 1975. 29p. (CONF-750607-37). Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

In analyses of hypothetical loss of flow accidents in the Fast Test Reactor (FTR), the safety analysis programs SAS and MELT are currently in use. These programs require as input a number of parameters including distributions of power density, fuel, sodium and stainless steel reactivity coefficients and Doppler weighting coefficients. Since the performing of 12-group three-dimensional calculations using models with normal mesh structure would be prohibitively expensive if calculation of physics parameters for more than a few configurations during the time frame of the accident was deemed necessary, the possibility of using a coarse mesh, few group model has been investigated. The accuracy of safety parameters computed using such a model is examined. (auth)

**14111** (HEDL-TME-75-47(Vol.1)) VOLUME 1. BASE TECHNOLOGY FSAR SUPPORT DOCUMENT: PREFAILURE TRANSIENT BEHAVIOR AND FAILURE THRESHOLD. Status Report, January 1975. Baars, R. E.; Culley, G. E.; Davis, R. T.; Henderson, R. G.; Scott, J. H. (comps.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 136p. Dep. NTIS $5.45.

A comprehensive compilation of the current (January 1975) state-of-the-art understanding of fuel pin response to reactivity insertion events up to and including failure threshold is presented. All mixed oxide fuel, transient overpower tests conducted to date are described and the data collected therein are presented. Current understanding of fuel pin cladding failure mechanisms is discussed, and interpretations of fuel pin cladding failure thresholds are presented as revealed by individual tests and by the several tests collectively. Plans for future tests are discussed. (auth)

**14112** (HEDL-TME-75-47(Vol.2)) VOLUME 2. BASE TECHNOLOGY FSAR SUPPORT DOCUMENT: PREFAILURE TRANSIENT BEHAVIOR AND FAILURE THRESHOLD. Status Report, January 1975. Baars, R. E.; Culley, G. E.; Davis, R. T.; Henderson, R. G.; Scott, J. H. (comps.). Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 269p. Dep. NTIS $7.60.

The FFTF fuel pin design and fabrication data, irradiation history and postirradiation examination results are summarized for the General Electric and Argonne National Laboratory transient experiments in TREAT. (auth)

**14113** (HEDL-TME-75-47(Vol.3)) VOLUME 3. BASE TECHNOLOGY FSAR SUPPORT DOCUMENT: PREFAILURE TRANSIENT BEHAVIOR AND FAILURE THRESHOLD. Status Report, January 1975. Baars, R. E.; Culley, G. E.; Davis, R. T.; Henderson, R. G.; Scott, J. H. (comps.). (Hanford Engineering Development Lab., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-2170. 295p. Dep. NTIS $10.00.

The FFTF fuel pin design and fabrication data, irradiation histories, and postirradiation examination results are summarized for the HEDL/TREAT transient test experimental programs. For each experiment, the data include: (a) fuel pin fabrication parameters, (b) steady-state irradiation history, (c) transient test design conditions, (d) transient test data, and (e) postirradiation examination results. (auth)

**14114** (HEDL-TME-75-70) REACTOR AND SAFETY ENGINEERING TECHNICAL PROGRESS REPORT, APRIL, MAY, JUNE 1975. Slember, R. J. (Hanford Engineering Development Lab., Richland, Wash. (USA)). Aug 1975. Contract AT(45-1)-2170. 94p. AT.

Progress is described in the areas of core physics, radiation and shield analysis, reactor dynamics, reactor safety, safety development, and systems safety analysis. (DG)

**14115** (INIS-mf-1773) GYLLING NAES NUCLEAR POWER STATION. (Jysk-Fynske Elsamarbejde (ELSAM), Fredericia (Denmark)). Jun 1974. 14p. (In Danish). INIS.

Brochure briefly listing authorities involved in and methods used for selection of location - Gylling Naes - for Denmark's first planned nuclear power station. Reasons for choice of site, consequences for local population, evacuation plans, etc., are described. Maps of site are given. (INIS)

**14116** (JAERI-M-5949) METHOD OF COMPUTING THE ANGLE FACTORS AMONG FUEL RODS IN CLAD SWELLING DURING LOCA. Abe, K. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 29p. (In Japanese). INIS.

Radiation heat transfer between the fuel rods is important in analysis of a loss-of-coolant accident. A method of computing the angle factors among fuel rods is reported. (The angle factor is defined as the fraction of total radiant energy from a radiating body which strikes an irradiated body.) The assumptions made are: the radiation as two-dimensional, emissivity and temperature uniform on the surface of a radiating body, no bowing, and the cross section of a fuel-rod cladding as perfect circle before and after swelling. The shadow area method, which is a general calculation of the angle factor, is used instead of Lambert's equation. The method developed is based on orthography, and the angle factor is given as a function of the shadow areas of radiating and the irradiated bodies by parallel rays. It enables analytical calculation of the angle factors among fuel rods for any degree of clad swelling. Prompt and accurate computation is possible each time the LOCA analysis predicts the swelling. (auth)

**14117** (JAERI-M-5958) FREG-1: A COMPUTER PROGRAM FOR CALCULATING THE GAP CONDUCTANCE IN OXIDE FUEL PINS. Harayama, Y.; Izumi, F.; Fujita, M.; Yamada, R.; Morishima, A. (Japan Atomic Energy Research Inst., Tokyo). Jan 1975. 51p. (In Japanese). INIS.

The USAEC decided in 1972 that GAPCON be used for evaluation of the effect of $UO_2$ pellet densification on the radial gap conductance. Preparation of the GAPCON for Japan for safety evaluation of fuel rods was deemed necessary. The computer program FREG-1 has been provided by revising mis-programs in GAPCON and incorporating new options. The explanation of FREG-1 is given. (auth)

**14118** (JPNRSR-13) EXPERIMENTAL INVESTIGATION OF SAFETY AGAINST UNSTABLE FRACTURE OF THE PRESSURE COMPONENTS OF NUCLEAR REACTORS. (Japan Welding Engineering Society, Tokyo). Feb 1975. Translation of a Japanese Report. 297p. Dep. NTIS $9.25.

Work performed under United States Nuclear Regulatory Commission–Light Water Reactor Safety Technical Exchange Program.

A study was made to determine if the Japanese standard that specifies a minimum usable temperature 50°C to the high temperature side at below the yield point even when the yield stress is very slightly exceeded is reasonable in specifying the allowable plastic region for certain types of nuclear reactor containment vessel incidents. This study was conducted in the form of large scale brittle fracture propagation termination tests on weld joints made on A516 Gr.70 steel plate for nuclear containment vessels, and the results were combined with the results

on tests made on base material last year. It was judged that the demands of the present specifications were excessive. It also seems that there is need for more logic being incorporated into the present safety standards that are based on CAT curves of fracture analysis diagrams (FAD) that rely on NDT temperatures from drop weight tests. (auth)

**14119** (KFK-2193) RESULTS OF MEASUREMENTS OF THERMAL INTERACTION BETWEEN MOLTEN METAL AND WATER. Zyszkowski, W. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany)). Oct 1975. 90p. Dep. NTIS (US Sales Only) $5.00.

Results are presented of an experimental investigation into thermal interaction of molten metals with water. The experiments were performed in two stages: the aim of the first stage was to study the general character of thermal interaction between molten metal and water and to measure the Leidenfrost temperature of the inverse Leidenfrost phenomenon. The second stage was directed to the experimental study of the triggering mechanism of thermal explosion. (auth)

**14120** (LA-6106-MS) PRELIMINARY TOPICAL REPORT ON COMPARISON REACTOR DISASSEMBLY CALCULATIONS. McLaughlin, T. P. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1975. Contract W-7405-ENG-36. 36p. Dep. NTIS $4.00.

Preliminary results of comparison disassembly calculations for a representative LMFBR model (2100-l voided core) and

Preliminary results of comparison disassembly calculations for a representative LMFBR model (2100-l voided core) and arbitrary accident conditions are described. The analytical methods employed were the computer programs: FX2-POOL, PAD, and VENUS-II. The calculated fission energy depositions are in good agreement, as are measures of the destructive potential of the excursions, kinetic energy, and work. However, in some cases the resulting fuel temperatures are substantially divergent. Differences in the fission energy deposition appear to be attributable to residual inconsistencies in specifying the comparison cases. In contrast, temperature discrepancies probably stem from basic differences in the energy partition models inherent in the codes. Although explanations of the discrepancies are being pursued, the preliminary results indicate that all three computational methods provide a consistent, global characterization of the contrived disassembly accident. (auth)

**14121** (LA-6127-MS) EFFECTS OF NEUTRON STREAMING AND GEOMETRIC MODELS ON MOLTEN FUEL RECRITICALITY ACCIDENTS. McLaughlin, T. P. (Los Alamos Scientific Lab., N. Mex. (USA)). Oct 1975. Contract W-7405-Eng-36. 14p. Dep. NTIS $4.00.

A postulated fast reactor accident which has been extant for many years is a recriticality following partial or complete core melting. Independently of the cause or probability of such a situation, certain cases can be defined and some facets of the dynamic history of these cases can be described with more than enough accuracy for safety considerations. Calculations were made with the PAD code for systems with 10 vol percent voids and varying reactivity insertion rates. Additionally, two distinct geometric and equation of state models were investigated in conjunction with a model which accounted for possible neutron streaming reactivity effects. Significant results include fission and kinetic energy, temperatures and pressures. (auth)

**14122** (LA-UR-75-2316) ANALYTICAL MODELS AND RELATED EXPERIMENT NEEDS FOR POST-ACCIDENT HEAT-REMOVAL RESEARCH. Boudreau, J. E. (Los Alamos Scientific Lab., N. Mex. (USA)). Nov 1975. Contract W-7405-Eng-36. 9p. (CONF-751141-4). Dep. NTIS $3.50.

From meeting on fuel and clad motion diagnostics in LMFBR safety test facilities; Albuquerque, New Mexico, USA (11 Nov 1975).

A brief discussion is presented of critical LMFBR post-accident heat removal phenomena and the related generic phenomena which must be included in any realistic analysis of the behavior of post-accident core debris. The current status of modeling in this area is described, and experimental needs are listed. (DG)

**14123** (NEDO-13435) MARK III CONFIRMATORY TEST PROGRAM: ONE THIRD SCALE, THREE VENT AIR TESTS. McIntyre, T. R.; Myers, L. L.; Torbeck, J. E.; Booker, R. J. (General Electric Co., San Jose, Calif. (USA). Boiling Water Reactor Systems Dept.). Oct 1975. 101p. General Electric Co., San Jose, CA.

A series of air blowdown tests was run to evaluate pool swell phenomena for the Mark III pressure suppression containment concept. The tests were performed at the Pressure Suppression Test Facility which consists of an integrated system of drywell, vent system, and suppression pool. The volumetric scale factor used for facility design was nominally 1 : 130, based on the BWR 6/251 series Mark III containment design. The pool and vent system both represented one-third scale mockups of an 8-degree sector of the Mark III containment, including a vertical row of three $15^{7}/_{8}$ in. (403 mm)-diameter horizontal vents. Test parameters changed were blowdown flow restrictor size and top vent centerline submergence. The transient responses of the pressurizer, drywell, vent system, suppression pool, and wetwell air space were measured and analyzed for use in formulating and/or further confirming the analytical models used for predicting loss-of-coolant accident transients. Results supported previously reported conclusions. Air blowdown tests with comparable drywell pressure transients were shown to have somewhat higher pool swell velocities than previously reported steam tests. The air tests provided additional evidence that bubble breakthrough elevation is not dependent upon charging rate but is determined almost exclusively by initial vent submergence. Total impulse values on the pool ceiling for the air tests were found to be lower than comparable steam tests. (auth)

**14124** (ORNL-5083) SIMTRAN I: A COMPUTER CODE FOR THE SIMULTANEOUS CALCULATION OF OXYGEN DISTRIBUTIONS AND TEMPERATURE PROFILES IN ZIRCALOY DURING EXPOSURE TO HIGH-TEMPERATURE OXIDIZING ENVIRONMENTS. Malang, S. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 145p. Dep. NTIS $7.60.

SIMTRAN I is a Fortran IV computer program written for the IBM 360/91 system which solves SIMultaneously the TRANsport equations for both heat and mass flow for the one-dimensional, multiphase, moving-boundary, transient-temperature transport problem in a finite-geometry system defined by cylindrical coordinates. The code utilizes an ideal diffusion model which requires uniform layer growth of all phases and assumes the existence of thermodynamic equilibrium at all interfaces at all times. While SIMTRAN was constructed specifically for the consideration of oxidation phenomena during the reaction of Zircaloy fuel tubes with steam under high-temperature transient oxidation conditions, only minor changes are necessary to make it generally applicable to other materials and a number of oxidation, diffusion, and heat-transfer problems. A variety of boundary-condition options permit the mathematical simulation of a wide range of oxidation experiments. The basic operational input to the code, which must include physical property, thermodynamic, and kinetic data over the desired temperature range, was selected from a variety of literature sources.

**14125** (ORNL-TM-4984) COMMON-MODE FAILURE MECHANISMS IN NUCLEAR PLANT PROTECTION SYSTEMS. Hayden, K. C. (Oak Ridge National Lab., Tenn. (USA)). Dec. 1975. Contract W-7405-eng-26. 31p. AT.

A broad class of failure mechanisms that can cause common-mode failures in nuclear plant protection systems and other high-reliability systems was studied. This class includes causes of multiple failures that in the past have not been widely recognized as common-mode failure mechanisms. These mechanisms were deduced from reactor operating experience, reports, and related literature. Several categories of multiple failure mechanisms are proposed as a starting point for the development of design and operating guidelines for reducing the probability of common-mode failures. Some of these categories represent classes of failure mechanisms that will be either difficult or impossible to incorporate correctly into numerical failure-probability analysis techniques which are based on reliability data on individual components and which assume no coupling, or at least some well-understood coupling, of redundant devices or subsystems. (auth)

**14126** (ORNL-TM-5075) HTGR SAFETY STUDIES. Quarterly Progress Report for the Period Ending March 31, 1975 for the Gas-Cooled Reactors Branch, Division of Reactor Licensing. Sanders, J. P. Jr. (Oak Ridge National Lab., Tenn. (USA)). Nov 1975. Contract W-7405-eng-26. 42p. Dep. NTIS $4.00.

Information is presented concerning cooling system performance during post shutdown operation, core auxiliary coolant system accident performance, loss of forced circulation thermal analysis, and air ingress rates to the primary system following a DBDA. (DCC)

**14127** (ORNL-TM-5140) EVALUATION OF THERMAL RESPONSE IN FORT ST. VRAIN REACTOR PRIMARY SYSTEM TO A DESIGN BASIS DEPRESSURIZATION ACCIDENT FOLLOWED BY COOLING WITH TWO PELTON WHEEL DRIVES OPERATING AT 7000 RPM. Sanders, J. P.; Turner, W. D.; Ball, S. J.; DeVault, R. M.; Giles, G. E.; Paul, D. D. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 46p. Dep. NTIS $5.50.

Independent computations have been performed at ORNL to determine the thermal and hydraulic response of the primary system of the Fort St. Vrain reactor to a specified design basis

depressurization accident (DBDA). For this accident it is stated that two of the four auxiliary drives on the circulators start operating at 7000 rpm after a 5-min delay. The calculations at ORNL supported the values given by the General Atomic Co. for primary system flow and pressure loss, and they confirmed the heat removal capacity of the flooded steam generators. The fuel and outlet helium temperatures calculated by ORNL generally reached higher values during the transient due to the fact that the ORNL calculations were performed using a single-channel calculation that could not include the effect of interregional heat conduction. An ORNL code that is developmental, but which includes interregional conduction, agrees well with the GAC values. The results of these calculations are presented graphically. 18 references. (auth)

**14128** (ORNL-TM-5205) MONTHLY PROGRESS REPORT FOR NOVEMBER 1975 FOR THE HTGR SAFETY STUDIES FOR THE DIVISION OF TECHNICAL REVIEW, U.S. NUCLEAR REGULATORY COMMISSION. Sanders, J. P. (Oak Ridge National Lab., Tenn. (USA)). Dec 1975. Contract W-7405-eng-26. 9p. Dep. NTIS $4.50.

Progress concerning the analysis of the transient response of HTGR systems under abnormal conditions is briefly reported. (JWR)

**14129** (REG/G-1.97(12-75)) INSTRUMENTATION FOR LIGHT-WATER-COOLED NUCLEAR POWER PLANTS TO ASSESS PLANT CONDITIONS DURING AND FOLLOWING AN ACCIDENT. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Dec 1975. 4p. NUREG.

**14130** (RLO-1388-296) ENERGY CONTROVERSY: THE ROLE OF NUCLEAR POWER. Schmidt, F. H.; Bodansky, D. (Washington Univ., Seattle (USA). Dept. of Physics). Feb 1975. 101p. Dep. NTIS $6.50.

The objective of the paper presented is to show that nuclear fission power is the best, and maybe the only, alternative source of energy. It is written for a wide range of readers, including non-scientists and scientists who are not particularly informed on the issues involved. The first question considered concerns man's need for energy; it is concluded that conservation measures alone cannot suffice. Next, the earth's energy sources are examined, and the extent of each is estimated in the simple context of the length of time it could last at present use rates. Only nuclear fission, nuclear fusion, and solar energy can provide for future time scales commensurate with man's historic past, while avoiding the possibility of catastrophic social upheaval. Fusion and solar energy are rejected on technological grounds because the world energy problem is so pressing that one cannot gamble on hopes for future technological breakthroughs. Thus, only nuclear fission meets the twin criteria of technological feasibility and adequate resource base. Each of the controversial issues surrounding nuclear fission energy is examined in some detail. The conclusion is reached that none is serious, and that nuclear fission offers by far the best energy source from environmental, economic, longevity, and overall safety standpoints. (auth)

**14131** (SAND-75-0632) LIGHT WATER REACTOR SAFETY RESEARCH PROGRAM. Quarterly Report, July-September 1975. Butcher, B. M. (ed.). (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 72p. Dep. NTIS $6.00.

Progress is reported in the following areas: molten core-concrete interactions study, and steam explosion phenomena.

**14132** (SAND-75-0653) STATISTICAL ANALYSIS OF LOCA, FY 75 REPORT. Steck, G. P.; Dahlgren, D. A.; Easterling, R. G. (Sandia Labs., Albuquerque, N. Mex. (USA)). Dec 1975. Contract AT(29-1)-789. 81p. Dep. NTIS $6.00.

The propagation of probability distributions through a complicated function to form the resulting distribution is considered. Seven techniques are discussed and the Monte Carlo and Response Surface methods are evaluated on two test problems. The results indicate reasonably accurate results can be obtained and that the Response Surface is the most efficient technique. (auth)

**14133** PROTECTION DEVICE FOR COOLING SYSTEMS. (to British Nuclear Design and Construction Ltd.). French Patent 2,227,603/A/. 24 Apr 1974. Priority Date 25 Apr 1973, United Kingdom of Great Britain and Northern Ireland (UK). 19p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

The protection device is designed for a pressurized liquid-circulation cooling system in which the fluid is a liquid, vapor, or two-phase fluid. A reservoir is arranged to inject the fluid under pressure by an injector in order to maintain a fluid flow across the region during a certain duration following a drop of the feed pressure of the fluid in normal circulation. This drop can be caused, for example, by a rupture in a part of the system upstream from the region. The invention is applicable to the protection of the cooling system of a nuclear reactor. (tr-FR)

**14134** SAFETY OF NUCLEAR POWER PLANTS. Barrere, M. Recherche (Paris); 6: No. 55, 305-317(Apr 1975). (In French)

The safety characteristics of the reactors in the type retained for the French programme are discussed in the limits of the actual possibilities of evaluation. The administration and regulation mechanisms put in service for controlling this safety are reviewed. A tentative answer to questions about the confidence to be paid to them is presented. (FR)

**14135** USE OF RELIABILITY AND PROBABILISTIC METHODS IN THE FIELD OF REACTOR SAFETY. Carnino, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service d'Etudes Techniques de Surete). Arts Metiers.; No. 3, 9-15(Apr 1975). (In French)

The most suitable tool for a numerical evaluation of nuclear reactor safety seems to be calculating accident probabilities and their consequences. Before quantifying accident probabilities, probabilistic evaluations of the reliability of the systems related to reactor safety are developed: event and fault trees and logical diagrams. The principal results from the WASH-1400 report (Rasmussen report) illustrate the use of reliability and probabilistic methods in safety analysis for the evaluation of nuclear accident risks against other risks. (FR)

**14136** COMBINED DRY/WET-COOLING TOWERS: THEIR ENVIRONMENTAL PROMISE AND THEIR PROBLEMS. Boegh, P.; Bhargava, N. (Motor-Columbus Ingenieurunternehmung A. G., Baden (Switzerland)). pp 45-61 of Environmental Effects of Cooling Systems at Nuclear Power Plants. Proceedings of a Symposium on the Physical and Biological Effects on the Environment of Cooling Systems and Thermal Discharges at Nuclear Power Stations Organized by the IAEA with the cooperation of the Secretariat of the United Nations Economic Commission for Europe and Held in Oslo, 26-30 August 1974. Vienna; IAEA (1975).

From symposium on the physical and biological effects on the environment of cooling systems and thermal discharges at nuclear power stations; Oslo, Norway (26 Aug 1974).

The advanced technology of natural-draught cooling towers has led to their adoption for cooling most thermal power plants in Europe. Some impacts, such as the shadowing effect of the visible plume and the water consumption caused by the evaporation losses of the towers, are controversial matters at several sites. Also, the cumulative effect of the humidity release of the several large new plants, located not far from one another, may lead to problems due to increased cloud formation. The dry-cooling tower does solve the problem of the visible plume but the impact on the landscape owing to the tower's large dimensions cannot be ignored. Also, reduction of plant efficiency will lead to a greater consumption of natural energy resources. This paper presents briefly some ideas of combining wet and dry towers. The preliminary results of calculations with the program SAMOA for a 900-MW(e) nuclear power plant with different cooling systems are discussed. The study has shown that the superheating of the plume at tower outlet is a necessary but not sufficient condition for plume reduction. (auth)

**14137** THERMAL AND RADIATION STABILITY OF SPRAY SOLUTIONS IN REACTOR CONTAINMENTS. Habersbergerova, A. Jad. Energ.; 20: No. 10, 356-357(Oct 1974). (In Czech)

Thermal and radiation stabilities of substances designed for the retention of various volatile chemical forms of radioiodine in spray solutions are discussed. Promising are alkaline solutions of sodium thiosulphate and of sodium borate. (INIS)

**14138** EXPERIMENTAL RESEARCH INTO FAST REACTOR SAFETY. Suchomel, J. Jad. Energ.; 21: No. 1, 35-37(Jan 1975). (In Czech)

The results are briefly surveyed of experimental studies of LMFBR operation safety. Hypothetical accidents are discussed, such as sodium coolant nucleation, fuel melting, interaction of molten fuel and sodium, and nuclear destructive explosions. Post-accident emergency cooling is also dealt with. The role of the containment as a means of limiting the consequences of hypothetical destructive accidents is emphasized. (INIS)

**14139** LIGHT-WATER REACTORS. Safety Problems and Related Studies in France. Lelievre, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Surete Nucleaire). pp 171-173 of La Maturite de l'Energie

Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The program of theoretical and experimental studies developed by the CEA on the safety of PWR reactors is presented: studies relative to the consequences of a LOCA following a rupture of the primary system, studies relative to fuel element behavior, studies on steels, reliability studies and studies of non-destructive testing methods. (FR)

**14140** METHODS AND TECHNIQUES OF THE EVALUATION OF THE SECURITY PROBABILITY OF NUCLEAR REACTORS. Procaccia, M.; Philippe, J. M. (Electricite de France, 93-Saint-Denis. Service Generateurs et Echangeurs de Chaleur Thermiques). pp 178-179 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Methods and technics for evaluating the safety probability of nuclear reactors are presented. Their applications to the electric power supply of the emergency standby of an ordinary water reactor and to different residual energy output circuits of a high power reactor are considered. (FR)

**14141** PAT-REC-DE CODE: EVALUATION OF COMMON MODE FAILURES IMPACT AND RELIABILITY. Blin, A.; Carnino, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Surete Nucleaire); Jubault, G.; Mollard, C. (Groupement pour les Activites Atomiques et Avancees (GAAA), 92-Le Plessis-Robinson (France)). pp 181-185 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The reliability of intermediate cooling water loops of BWR residual heat removal systems was studied. The PAT-REC-DE code enables treating the dependence problems in a fault tree. (FR)

**14142** SAFETY CRITERIA FOR THE SUPER-PHENIX REACTOR. Justin, F. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Surete Nucleaire); Argous, J. P. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides); Giudicelli, A. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)). pp 185-187 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The design of Super-Phenix regarding safety aims at maintaining the integrity of the successive barriers put between the radioactive products and the public, and at satisfying the regulation on radioactive releases during normal operation. In the event of a most severe core accident, it aims at maintaining at least two of these barriers in a safe state. (FR)

**14143** CALCULATIONS COMPARED WITH EXPERIMENTS SIMULATING DIFFERENT BLOWDOWNS. Friz, G.; Riebold, W. (Commission of the European Communities, Ispra (Italy). Joint Nuclear Research Center); Lange, D.; Megnin, J. C. (Groupement pour les Activites Atomiques et Avancees (GAAA), 92 - Le Plessis-Robinson (France)). pp 190-191 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The results of PWR depressurization experimental studies carried out by EURATOM on the DHT1 test loops are compared with those obtained by GAAA, using the KAPCOR depressurization computer code. The agreement between these results is generally good and underlines the usefulness of the KAPCOR code. (FR)

**14144** HIGH TEMPERATURE REACTOR SAFETY AND ENVIRONMENT. Brisbois, J. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques); Chapelot, A. (Societe Technique pour l'Energie Atomique (Technicatome), Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France)); Charles, J. (Societe pour les Reacteurs Nucleaires HTR (S.H.T.R.), 92 - Courbevoie (France)). pp 187-190 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

High-temperature reactors are endowed with favorable safety and environmental factors resulting from inherent design, main-component safety margins, and conventional safety systems. The combination of such characteristics, along with high yields, prove in addition, that such reactors are plagued with few problems, can be installed near users, and broaden the recourse to specific power, therefore fitting well within a natural environment. (FR)

**14145** INTRODUCTION TO SYMPOSIUM "EFFECTS OF USE OF NUCLEAR AND FOSSIL ENERGY SOURCES WITH REGARD TO HEALTH AND ENVIRONMENT". Lamberts, H. B. (Rijksuniversiteit Groningen (Netherlands)). Atoomenerg. Haar Toepass.; 17: No. 9, 169(Sep 1975). (In Dutch).

From symposium on the effects of use of nuclear and fossil energy sources with regard to health and environment; Utrecht, The Netherlands (4 May 1975).

It is estimated that by 1985 Holland will have three nuclear powered generating stations, with a total capacity of 1000 MW(e), overtaking gas, oil, and coal as energy sources. Modern developments will make these as safe in operation as those in current use, both from the general pollution aspect and from the risk of accident aspect. (NL)

# Reactor Theory and Calculation

**14146** (AECL-5105) FISSPROD-2: AN IMPROVED FISSION PRODUCT ACCUMULATION PROGRAM. Walker, W. H. (Atomic Energy of Canada Ltd., Chalk River, Ontario. Chalk River Nuclear Labs.). Aug 1975. 66p. Dep. NTIS (US Sales Only) $5.50. AECL $1.50.

The program FISSPROD has been extensively revised since it was described in AECL-3038. The new version, FISSPROD-2, incorporates the following major changes: (1) Translation from APEX (G-20) to FORTRAN-IV for the CDC-6600. Data library expansion to about 800 nuclides. The yield and $\beta$-decay data used are extracted from the ENDF/B(IV) fission product library. (3) The ability to accumulate the fission product inventory from several fissile species during the same irradiation (e.g. from $^{235}U$, $^{238}U$, $^{239}Pu$, and $^{241}Pu$ in natural U fuel). The original program calculated fission product accumulation from only one fissile nuclide for each case. (4) An expanded output with several options, namely, absorption cross sections in barns per fission (as in the original program) fission product accumulation in grams of fission products per kg of fuel fissioned, radioactivity in Ci/kg fissioned, and decay heat ($\beta$ and $\gamma$) in MeV/fission and Watts/kg fissioned. These options are available singly or in total, either in summary or with a detailed output. Quantities listed above as x/kg fissioned can be obtained as x/kg initial heavy elements if preferred. (5) Transfer of some arrays to extended core storage and deletion of several others to minimize the increase in central memory requirements associated with the expansion of the data library. (auth)

**14147** (CEA-N-1802) FLICA III: A DIGITAL COMPUTER PROGRAM FOR THERMAL-HYDRAULIC ANALYSIS OF REACTORS AND EXPERIMENTAL LOOPS. Plas, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). May 1975. 45p. (In French). INIS.

This computer program describes the flow and heat transfer in steady and transient state in two-phase flows. In the mathematical model all the significant terms of the fundamental hydrodynamic equations are taken into account with the approximations of turbulent viscosity and conductivity. The two-phase flow is calculated by the homogeneous model with slip. In the flow direction an implicit resolution scheme is available, which makes possible to study partial or total flow blockage, with upstream and downstream effects. A special model represents the helical wire effects in out-of pile experimental rod bundles. (FR)

**14148** (CEA-N-1807) ANALYSES OF BREAKING MECHANICS BY THE FINITE ELEMENT METHOD. On the Meaning of J Integrals and Analogues. Roche, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Jul 1975. 70p. (In French). INIS.

Calculations carried out at Saclay by the method of finite ele-

ments show that the value of the integral $J_1$ depends on the contour chosen, when this latter passes through a zone which has undergone plastic deformation. An outline of the Boussinesq stress tensor properties is followed by an examination of the elastic energy density distribution, centered on cases where this depends not only on the deformation but also explicitly on the point considered. It is then useful to introduce the energy-impulsion tensor of the field theory. Any zone where the elastic energy density depends explicitly on the point considered is taken as a defect. The total energy variation of the body-loading device system in the event of development of the defect can be calculated, and is expressed in certain cases by surface integrals $J_1$ (translation) L (rotation). (FR)

**14149** (CONF-750607-29) RELATIONSHIP OF OBSERVED FLOW PATTERNS TO GAS CORE REACTOR CRITICALITY. Macbeth, P. J.; Kunze, J. F.; Rogers, V. C. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA). Idaho National Engineering Lab.; Brigham Young Univ., Provo, Utah (USA)). 1975. 4p. Dep. NTIS $4.00.

From American Nuclear Society meeting; New Orleans, Louisiana, USA (8 Jun 1975).

The gas core reactor requires the establishment of stable and unique flow patterns. A recent series of room temperature flow tests have studied the hydrodynamics, particularly involving gases of differing densities. In an actual operating gas core reactor, the central gas of vaporized uranium will have a much higher density than the surrounding coolant. Testing was done in two different sized chambers (18 inch and 36 inch diameter) to study hydrodynamic scaling. Air was employed as the "coolant" gas. Air, argon, and freon, smoked for identification, was used to simulate the fuel. A variety of injectors at various locations in the cavity were employed. (auth)

**14150** (CONF-750977-, pp 18.1-18.63) COMPARISON OF SEVERAL ALGORITHMS FOR IDENTIFICATION OF NOISY SYSTEMS. Price, J. B. (Air Force Systems Command, Wright-Patterson AFB, OH). 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

Identifying the parameters of an input-output system is complicated if there is any noise in the system due to measurement error, input noise or some inherent random variation. There are several computational algorithms for identifying a reactor system in this noisy or stochastic environment. Several algorithms are presented comparatively and evaluated relative to their success in identifying simulated data and data from a nuclear reactor system. The simulated data are first, second, third, fourth, and fifth order test cases; the reactor data is a fifth order system (EBR-II). The systems considered are linear, constant coefficient, single input-output with measurement noise only. (auth)

**14151** (CONF-750977-, pp 21.1-21.28) DIAGNOSTICS OF VOID FLUCTUATIONS IN A REACTOR COOLANT CHANNEL USING NEUTRON NOISE TECHNIQUES. Lu, J. T.; Danofsky, R. A.; Struss, R. (Iowa State Univ., Ames). 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

An experimental investigation has been initiated to study the characteristics of the local neutron detector response perturbations due to the stochastic nature of coolant void formation and motion in a water channel. Measurements of the neutron transmission through a water channel containing air and steam bubbles have been performed. Auto-power spectral densities and probability density functions of the detected stochastic component of the transmitted neutron beam have been found to be very sensitive to the characteristics of the bubble generation and motion. (auth)

**14152** (COO-2262-7) FINITE ELEMENT METHOD FOR NEUTRON DIFFUSION PROBLEMS IN HEXAGONAL GEOMETRY. Wei, T. Y. C.; Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge (USA). Dept. of Nuclear Engineering). Jun 1975. Contract AT(11-1)-2262. 311p. Dep. NTIS $9.75.

Thesis.

The use of the finite element method for solving two-dimensional static neutron diffusion problems in hexagonal reactor configurations is considered. It is investigated as a possible alternative to the low-order finite difference method. Various piecewise polynomial spaces are examined for their use in hexagonal problems. The central questions which arise in the design of these spaces are the degree of incompleteness permissible and the advantages of using a low-order space fine-mesh approach over that of a high-order space coarse-mesh one. There is also the question of the degree of smoothness required. Two schemes for the construction of spaces are described and a number of specific spaces, constructed with the questions outlined above in mind, are presented. They range from a complete non-Lagrangian, non-Hermite quadratic space to an incomplete ninth order space. Results are presented for two-dimensional problems typical of a small high temperature gas-cooled reactor. From the results it is concluded that the space used should at least include the complete linear one. Complete spaces are to be preferred to totally incomplete ones. Once function continuity is imposed any additional degree of smoothness is of secondary importance. For flux shapes typical of the small high temperature gas-cooled reactor the linear space fine-mesh alternative is to be preferred to the perturbation quadratic space coarse-mesh one and the low-order finite difference method is to be preferred over both finite element schemes. (auth)

**14153** (DP-MS-75-74) ACCELERATION TECHNIQUES FOR RESPONSE MATRIX METHODS. Sicilian, J. M.; Pryor, R. J. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. (USA). Savannah River Lab.). 1975. Contract AT(07-2)-1. 22p. (CONF-751101-40). Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Application of the power iteration method to the multigroup response matrix equations reduces them to a series of one-group problems. Applying acceleration techniques to each of these monoenergetic problems results in substantial reductions in computational effort. The use of point over-relaxation methods in the solution of these equations is described. Over-relaxation is also applied to the outer-iteration eigenvalue and source estimations with considerable success. 10 references. (auth)

**14154** (IFA-TR-59-1974) DETERMINATION OF UNCERTAINTY COEFFICIENT BY THE STANDARD ERROR METHOD FOR THE ELEMENT CAN TEMPERATURE. Georgescu, R. (Institutul de Fizica Atomica, Bucharest (Romania)). 1974. 17p. (In Russian). INIS.

The standard error method was used for the determination of the temperature of the walls of fuel element cans. In comparison with the usual methods, this method gives an increase of up to 30 to 40% for the liquid inlet temperature in the active zone of the reactor. (tr-auth)

**14155** (JAERI-M-5971) EXPERIMENTAL ANALYSIS OF THE CENTRAL REACTION-RATE IN A GAS-COOLED FAST REACTOR. Osugi, T.; Yoshida, H. (Japan Atomic Energy Research Inst., Tokyo). Feb 1975. 13p. (In Japanese). INIS.

Experimental analysis of the central reaction-rate ratios in a gas-cooled fast reactor, obtained with reactor PROTEUS, has been made with the JAERI-FAST group constants and diffusion theory with anisotropic diffusion coefficients recommended by Benoist. Effective macroscopic group constants were prepared using the collision probability method, to consider heterogeneity of the cells. The relative values of fission rate of $^{239}Pu$ (F9), $^{238}U$ (F8) and $^{235}U$ (F5), and the ratio of $^{238}U$ capture (C8) to $^{239}Pu$ fission rates were obtained. There is no difference in reaction-rate ratio between the homogeneous and heterogeneous systems. The measured to calculated values, C/E, are the $1.067 \pm 0.017$, $0.972 \pm 0.016$, $1.006 \pm 0.015$ for C8/F9, F8/F9 and F5/F9, respectively. (auth)

**14156** (JAERI-M-6038) CALCULATION PROGRAM FOR FAST REACTOR DESIGN. I. PIGEON: Program for Calculating the Cell Heterogeneity by Collision Probability Method. Osugi, T.; Yoshida, H.; Ihara, H. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 40p. (In Japanese). INIS.

The program PIGEON is used for calculating the effective group constants considering the heterogeneity of the cells in a fast reactor by collision probability method. The effective group constants are calculated in averaging over the cell, using the spatial fine neutron distribution. The anisotropic diffusion coefficients in the cell are calculated from Benoist's formula. The group constants for the cell are stored in disk or magnetic tape, and are prepared by PEDIT for use in the diffusion theory code (CITATION or Mod. CITATION) and transport theory code (TWOTRAN). The program is written in FORTRAN-IV for computer FACOM 230/60 or CDC 6600. (auth)

**14157** (JAERI-M-6062) DENSITY COEFFICIENT MEASUREMENTS IN FCA ASSEMBLY VI-1. Iijima, T.; Hirota, J.; Obu, M.; Kusano, J.; Yamagishi, K. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 9p. (In Japanese). INIS.

The results are given of density coefficient measurements in FCA Assembly VI-1 which is a physics mock-up of the Prototype Fast Breeder Reactor "MONJU". To obtain the density coef-

ficients for the one-region core of test zone composition, measurements were made on the system with a sector region which was constructed by replacing the 90° driver with the test zone drawers. The isotopic density coefficients for uranium and plutonium were obtained with high accuracy from the measurements using samples of different isotopic composition. The reactivity scale was calibrated by normalizing the measured fuel density coefficient to the calculated one. Equivalence of the sector to the one-region core is also described. (auth)

**14158** (JAERI-M-6063) APPLICABILITY OF THE DENSITY COEFFICIENT METHOD FOR LARGE FAST REACTORS. Iijima, T. (Japan Atomic Energy Research Inst., Tokyo). Mar 1975. 19p. (In Japanese). INIS.

Applicability of the Density Coefficient Method (D.C.M.) for large fast reactors has been studied, with the density coefficients of FCA Assembly VI-1. The method is to predict experimentally criticality of a given reactor, using the density coefficients obtained by critical experiment. It consists of two steps of extrapolation; i.e., core composition and core volume. For the former, accuracy in the criticality extrapolation is excellent. Criticality can be predicted with accuracy of 0.1% $\Delta k$ (0.3% $\Delta k$ including the reactivity scale error), even when the reactivity change due to composition change is over –30% $\Delta k/k$. Criticality can also be estimated for the core volumes about six times as large, with practical accuracy. (auth)

**14159** (KFK–2166) TRANSIENT HYDRAULICS AND HEAT TRANSFER IN A TURBULENT FLOW. Kawamura, H. (Gesellschaft fuer Kernforschung m.b.H., Karlsruhe (F.R. Germany)). Jun 1975. 54p. Dep. NTIS (US Sales Only) $4.00.

In a reactor transient analysis the friction factor and the heat transfer coefficient are assumed equal to the steady state values even in a transient state. An examination of this quasi-static assumption is described. The transient turbulent flow in a circular tube subjected to a step change of pressure drop was calculated numerically. Transient variations of the friction factor and the heat transfer coefficient were obtained. Effects of the Reynolds number and a wall heat capacity were studied. The quasi-static momentum equation was found to be approximately valid for both accelerated and decelerated turbulent flow. The quasi-static energy equation was also valid for the transients of gas cooled reactors. (auth)

**14160** STABILITY OF MOMENTS IN A SIMPLE NEUTRONIC SYSTEM WITH STOCHASTIC PARAMETERS. Karmeshu (Univ., Delhi); Bansal, N. K. (Univ., Delhi). Nucl. Sci. Eng.; 58: No. 3, 321-327(Nov 1975).

The exact expressions for the first- and second-order moments of neutron density and the delayed-neutron precursor density are derived for a neutron multiplying system with time-dependent stochastic perturbations in the reactivity and white noise source. The effect of finite correlation time of the reactivity on the stability of moments is discussed. For asymptotically long times, the moments are found to be stable. The exact expressions of the moments in the limiting case, when the reactivity correlation time becomes zero, are also derived. (auth)

**14161** MACROSCOPIC REPRESENTATION OF THE ANISOTROPIC NEUTRON FLUX SPECTRUM AND A NEW GREULING–GOERTZEL APPROXIMATION. Yamamura, Y. (Okayama Coll. of Science, Japan). Nucl. Sci. Eng.; 58: No. 3, 328-331(Nov 1975).

The macroscopic representation of complicated moderating processes has been investigated to describe the collision integral in the Legendre polynomial expansion of the neutron transport equation in terms of the macroscopic moderating parameter, defined as the ratio of the l'th-order Legendre component of the slowing-down density to the corresponding collision integral. This approach is similar in form to the Wigner-type continuous slowing-down theory, but the present moderating parameter is a function of lethargy, space, and time. For practical applications a new Greuling-Goertzel approximation is proposed based on the factorization of the angular flux. The present parameter, gamma/sub l/(u), is defined so as to compensate the difference between the lethargy spectrum of the space- and time-independent flux and the exact spectrum. (auth)

**14162** COMPUTER CODES IN NATURAL CONVECTION. Drut, R.; Mejane, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). Bull. Inf. Sci. Tech. (Paris); No. 197, 61-68(Nov 1974). (In French)

**14163** PRIMARY CIRCUIT HYDRODYNAMICS. Pfann, J. Jad. Energ.; 21: No. 2, 73-76(Feb 1975). (In Czech)

Opening paper of the seminar "Analysis of Transients in Fast Reactors" held in the summer semester of 1974 by the Faculty of Nuclear and Physical Engineering in Prague.

Principal equations of calculating coolant flow in the primary coolant circuit and general equations describing the behaviour of the coolant and its effect on the environment are indicated. The method of solving the equations and thus elaborating a mathematical description (model) of calculating both planned and emergency reactor transients is shown. (INIS)

**14164** THERMAL TRANSIENTS AND DYNAMICS OF NUCLEAR REACTORS. Hermansky, B. (Acta Polytech. (Prague), IV; No. 3, 21-48(1974). (In Czech).

The possibilities are discussed of the analysis of transient processes based on the knowledge of the mathematical model of a system. A formulation is made of a linear model with axially and radially distributed parameters of the nuclear reactor dynamics and general relations are presented for the computation of non-stationary temperatures. Specifically, some results are given of the studies in the KS-150 thermal reactor and the ZRR ceramic fuelled sodium cooled fast experimental reactor. (auth)

**14165** ADVANCED FINITE ELEMENT TECHNIQUES IN REACTOR THEORY. Woolley, R. W.; Walters, W. F. Paper 75-214. New York; American Institute of Aeronautics and Astronautics (1975). 8p.

From 13th American Institute of Aeronautics and Astronautics aerospace sciences meeting; Pasadena, CA, USA (20 Jan 1975).

The solution to the Helmholtz equation, encountered in nuclear reactor theory, is obtained with the finite element technique, employing linear and quadratic Lagrange and cubic Hermite interpolation polynomials, and compared with the classical finite difference result. Transforming the Helmholtz equation into a weak form, the application of the finite element method is possible. Comparing the eigenvalues obtained using different numerical schemes with analytic results, the cubic Hermite finite element technique yields the most accurate results and highest order of convergence for identical mesh spacing. Optimization of the computer programs may demonstrate considerable savings in computer time using the cubic Hermite finite element technique. The behavior of the solution for each of the various numerical methods is investigated as material discontinuities become more pronounced. (auth)

**14166** FOURIER SERIES SOLUTIONS OF CERTAIN HETEROGENEOUS PROBLEMS. Gorodkov, S. S. Sov. J. At. Energy (Engl. Transl.); 33: No. 6, vp.(Dec 1972).

Translated from At. Energ. (USSR); 33: No. 3, 986(Dec 1972). This is a summary of paper No. 628/6780 with full copy held at TIC.

Some problems associated with heterogeneous reactor calculations in the diffusion approximation can be reduced to the solution of a two-dimensional diffusion equation with an infinite set of $\delta$-sources. In addition to the problem of the Green's function for an infinite square lattice such problems include the Green's function for an infinite lattice with triangular and hexagonal cells, or a single rod in an assembly of rectangular cross section without a reflector. The solution of the diffusion equation with such a set of sources in an infinite moderator can be written as a double Fourier series. This series diverges logarithmically, however, at certain points, and this complicates the use of the solution in computer calculations. This difficulty can be removed by using a function which has the same singularities at the same points as the solution of the differential equation with the infinite set of sources. As an example of the possibilities of the proposed method a calculation is made for an exponential experiment performed on a few-channel assembly of square cross section without a reflector. (auth)

# Reactor Components and Accessories

*Refer also to abstract 12593.*

**14167** (BNL-20734) EVALUATION OF BURST PROBABILITY FOR TUBES BY WEIBULL DISTRIBUTIONS. Kao, S. (Brookhaven National Lab., Upton, N. Y. (USA)). Oct 1975. Contract E(30-1)-16. 15p. Dep. NTIS $3.50.

The investigations of candidate distributions that best describe the burst pressure failure probability characteristics of nuclear power steam generator tubes has been continued. To date it has been found that the Weibull distribution provides an acceptable fit for the available data from both the statistical and physical viewpoints. The reasons for the acceptability of the Weibull distribution are stated together with the results of tests for the suitability of fit. In exploring the acceptability of the Weibull distribution for the fitting, a graphical method to be called the "density-gram" is employed instead of the usual histogram. With this method a more

sensible graphical observation on the empirical density may be made for cases where the available data is very limited. Based on these methods estimates of failure pressure are made for the left-tail probabilities.

**14168** (CEA-CONF-3042) MODERN DIMENSIONING CRITERIA FOR PRESSURE VESSELS. Roche, R. (CEA Centre d'Etudes Nucleaires de Saclay, 91-Gif-sur-Yvette (France). Service des Etudes Mecaniques et Thermiques). 1975. 17p. (In French). INIS.

From national colloquium on the technology of pressure vessels; Paris, France (21 Apr 1975).

Some ideas on modern dimensioning criteria are given and their advantages with regard to both safety and economy are shown. In general these criteria result from considerations on possible damage to the apparatus in service and the modes of breakdown liable to follow. They are general enough to allow for a variety of dimensioning methods both experimental and theoretical, with special reference to modern computerized digital analysis techniques. As a practical example however some notions are given on the simplest means of computing dimensions in accordance with these criteria. (FR)

**14169** (CONF-750977-, pp 10.1-10.17) INSTRUMENTATION INTEGRITY AND RESPONSE TIME TESTING UTILIZING SYSTEM NOISE. Thie, J. A. 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

Methods illustrated show that selected passive noise analysis tests have distinct information gathering advantages and therefore should be considered for a place in instrumentation surveillance. This is especially true for monitoring the mechanical/hydraulic integrity of in-core neutron detectors and their environs. Special techniques in the optimum utilization of data for accuracy and sensitivity are encouraged in transfer function measurements and in assessing motional nonlinearities. Having a good multi-dimensional model now for understanding in-core neutron noise, experimental efforts can be fruitful--both in the usual time/frequency domain and possibly sometimes in a suggested space/wave-number domain. (auth)

**14170** (CONF-750977-, pp 23.1-23.37) MODELING OF NUCLEAR STEAM GENERATOR DYNAMICS. Bruens, N. W. S.; Brukx, J. F. L. M.; Latzko, D. G. H.; Vriesema, B. (Delft Univ., Netherland). 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

The modeling of steam generator dynamics is discussed for four different types of nuclear power plants, i.e. LMFBR, MSBR, PWR of an integrated design and loop-type PWR. The simulation models are developed within one basic modeling concept. They are capable of predicting steady state and transient thermal hydraulic behavior for both normal and fault operating conditions. Experimental results obtained from a single-tube molten salt heated steam generator are discussed. Sample results of the simulation models are presented with emphasis on the effects of the continuity equation upon transient behavior. (auth)

**14171** NATURAL DYNAMIC STABILITY OF THERMAL AND NUCLEAR POWER SETS AT 3000 AND 1500 REV/MIN. Caucheteux, G. (Electricite de France, 75 – Paris). Bull. Dir. Etud. Rech., Ser. B; No. 2, 19-26(1974). (In French)

The natural dynamic stability time limits were determined for the main types of power set, using a micro-network. By definition, the characteristic feature of natural dynamic stability is that speed governing is ineffective, i.e. a constant driving torque is applied to the machine shaft. The time limits give an order of magnitude of the performance to be expected from future power sets connected to the system in the 1980s, for which low-inertia conventional sets running at 3000 rev/min or high-inertia nuclear power sets at 1500 rev/min are envisaged. (FR)

**14172** THERMALLY INSULATING STRUCTURE. Barriere, A.; Rouge, P. (to Commissariat a l'Energie Atomique). French Patent 2,217,628/A/. 15 Feb 1973. 11p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention relates to the manufacture of thermally insulating structures adapted to be placed in direct contact with coolants. Modular members each comprise two equal elemental volumes having the stage of right parallelepipeds, the contacting screen faces of which are superimposed and assembled in such manner that all the pairs of parallel sides of said screen faces are equally offset. The invention applies to enclosures such as reactor vessels and containers for the chemical industry. (FR)

**14173** IMPROVEMENTS IN THE DEVICES FOR HANDLING THE FUEL OF ATOMIC REACTORS. (to Reel S. A.). French Patent 2,215,295/A/. 26 Jan 1973. 7p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

A handling device of the type associated to the platform of a travelling bridge and comprising a heat which is integral with an axially fixed but angularly adjustable outer tube wherein is coaxially mounted an inner tube adapted to slide with respect to the first tube is described. The inner tube has a gripping device at the free end thereof characterized in that the inner tube is angularly fixed with respect to the outer tube, while that tube and the head taken as a whole contain a mechanism for axially displacing the inner tube. The unit formed by the tube and the head is pivotally mounted with respect to the platform. (FR)

**14174** THERMO-ELECTRIC PUMP. Georges, J. L.; Veyret, J. F. (to CEA). French Patent 2,223,890/A/. 2 Apr 1973. 12p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

Description is given of a thermo-pump for electrically conductive liquid fluids, e.g. for a liquid metal such as sodium. This pump is characterized in that the piping for the circulation of the conductive liquid is constituted by a plurality of conduits defined by two co-axial cylinders and two walls parallel to their axis. Each conduit is limited outside by a magnet, inside by a mild-iron tube, and laterally by two materials forming a thermocouple. This can be applied to sodium circulation loops for testing nuclear fuel elements. (FR)

**14175** A STEAM SEPARATOR-SUPERHEATER APPARATUS. Androw, J.; Bessouat, R.; Peyrelongue, J. P. (to Societe Stein Industrie). French Patent 2,224,031/F/. 30 Mar 1973. 16p. (In French)

Addition to the French patent document: 7017472. Available from Institut National de la Propriete Industrielle, Paris (France).

Description is given of a separator-superheater apparatus comprising an outer enclosure containing a separating-unit and a steam superheating unit according to the main patent. The present addition relates to an improvement in that apparatus, characterized in that the separating unit and the superheating unit, mounted in two distinct portions of the outer enclosure, are divided into the same number of sub-units of each unit being identical and operating in parallel, and in that to each separator sub-unit is associated a superheater sub-unit. (FR)

**14176** ELECTRIC DIAGRAMS OF NUCLEAR POWER PLANTS. Marko, S.; Darula, I. Elektrotech. Obz.; 63: No. 11, 683-689(Nov 1974). (In Slovak).

General principles are presented of the electric circuit arrangement of nuclear power plants. Diagrams of internal power consumption are briefly described for various countries. Requirements for alternate power supplies and for a reliable supply of electrical equipment in case of accident are discussed. (INIS)

## Reactor Fuels

*Refer also to abstracts 11417 and 11927.*

**14177** (BLG-497) HIGH RATED IRRADIATION OF VIPAC (U, Pu)$O_2$ IN DIOGENES. Peter, J.; Schumacher, H.; van Outryve d'Ydewalle, B.; Aerts, L.; Bairiot, H. (Societe Belge pour l'Industrie Nucleaire, Brussels; Eidgenoessisches Inst. fuer Reaktorforschung, Wuerenlingen (Switzerland); Centre d'Etude de l'Energie Nucleaire, Mol (Belgium)). Jul 1975. 45p. (BN-7507-04; EIR-272). Dep. NTIS (US Sales Only) $4.00.

A summary is presented of the manufacture, the irradiation behavior, and the postirradiation examinations of the DIOGENES fuel rods irradiated in the heavy water cooled loop DIOGENES of the DIORIT reactor between 1968 and 1970. The aim of the irradiation experiment was to perform tests at higher power and higher burnup and to compare the heterogeneous and the homogeneous fuels. (auth)

**14178** (BNWL-1897) USER'S GUIDE FOR GAPCON-THERMAL-2: A COMPUTER PROGRAM FOR CALCULATING THE THERMAL BEHAVIOR OF AN OXIDE FUEL ROD. Beyer, C. E.; Hann, C. R.; Lanning, D. D.; Panisko, F. E.; Parchen, L. J.

(Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Nov 1975. Contract E(45-1)-1830. 112p. Dep. NTIS $5.50.

This report is being published as a user's manual for GAPCON-THERMAL-2 and provides a general description of the code and instructions for its use. The GAPCON-THERMAL-2 code was developed for the Regulatory Staff, NRC, to use as a tool in estimating fuel-cladding gap conductances and fuel stored energy and represents a modification of the GAPCON-THERMAL-1 code. The goal of the modifications was to reduce uncertainties associated with calculating power history and burnup effects and yet retain a relatively flexible and fast running code for parametric studies. 15 references (auth)

**14179** (CONF-751101-14) ERROR ANALYSES ON THREE METHODS FOR EXPERIMENTALLY OBTAINING GAP CONDUCTANCE VALUES. Tolman, E. L.; Wells, M. E. (Aerojet Nuclear Co., Idaho Falls, Idaho (USA)). 1975. Contract AT(10-1)-1375. 4p. Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Gap conductance is a significant factor affecting the stored energy in a fuel rod at the beginning of a hypothetical accident sequence, as well as the thermal and mechanical response of the fuel rod during the accident. Additional well-characterized experimental results are needed to evaluate and improve the current analytical models used to calculate gap conductance during steady-state and transient reactor conditions. The basic difficulty in obtaining the needed data is the inherent uncertainty existing in any experimental method used to determine gap conductance information. The results of error analyses made on three experimental methods are presented and their relative uncertainties analyzed. (auth)

**14180** END FITTING FOR A NUCLEAR REACTOR FUEL ROD ASSEMBLY. (to Nuclear Fuel Services, Inc.). French Patent 2,220,846/A/. 9 Mar 1973. 12p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

The invention concerns an end fitting for a fuel rod assembly. The assembly consists of vertical support arms supporting an end fitting on the fuel rods. These support arms have reduced diameter constrictions extending into the openings made in the end fitting. Elastic split collars are arranged in grooves and engage with the end fitting. These collars can be subjected to bending with a special tool to withdraw the end fitting or to lower the end fitting onto the collar. (tr-FR)

**14181** LEAKAGE-LIMITER FOR NUCLEAR REACTOR FUEL ELEMENT FEET. Lambert, P. (to Alsthom). French Patent 2,222,731/A/. 22 Mar 1973. 8p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

An arrangement for limiting leakage at the foot, or bottom portion, of nuclear reactor fuel elements is described. According to the invention, a labyrinth is mounted in the space defined by the fuel element foot and its housing, and through orifices a portion of that space is put in communication with a coolant reduced pressure zone generated by a constriction. (FR)

## Reactor Control Systems

**14182** (ANL-CT-76-16) FLOW INDUCED VIBRATIONS OF THE HCM/FTR CONTROL ROD DRIVE MECHANISM. Turula, P. (Argonne National Lab., Ill. (USA)). Sep 1975. 33p. AT.

Available information relating to the vibration analysis of the FFTF control rod drive mechanism (CRDM) is presented. The basic vibration computations presented were carried out using the NASTRAN program and include a modal analysis and a frequency response determination. 8 references. (auth)

**14183** (CONF-750977-) PROCEEDINGS OF THE SECOND POWER PLANT DYNAMICS, CONTROL AND TESTING SYMPOSIUM, KNOXVILLE, TENNESSEE, SEPTEMBER 3–5, 1975. Kerlin, T. W. (ed.). (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering). 1975. vp. Univ. of Tennessee, Knoxville.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

Included are 22 papers on fossil fueled and nuclear power plant modeling, simulation, control, performance evaluation by dynamic testing, and incipient failure detection. A separate abstract was prepared for each paper for inclusion in NSA and/or ERA. (HDR)

*For abstracts of individual papers see: 13920, 13929–13931, 13977, 13978, 14025, 14150, 14151, 14169, 14170, and 14184–14187.*

**14184** (CONF-750977-, pp 11.1-11.38) ON-LOAD VIBRATION AND NOISE MONITORING IN SODIUM COOLED AND LIGHT WATER REACTORS. Basti, W.; Wach, D. 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

Monitoring systems capable of locating the sources of malfunctions in reactors frequently have no direct access to the parameters of interest. Indirect measuring methods are used where the neutron flux, pressure, and vibration signals are monitored and correlation techniques are applied. The results gained in applying these indirect methods and the methods used to interpret the signals are discussed. (HDR)

**14185** (CONF-750977-, pp 12.1-12.21) STUDY ON DIAGNOSIS SYSTEM OF NUCLEAR REACTOR AND POWER PLANT. Wakabayashi, J.; Yamaguchi, K.; Ina, S.; Kondo, J. (Kyoto Univ.). 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

Two reactor noise analysis systems are described. In one of the systems, a Kalman filter is used to estimate the internal state vector which is used in the diagnosis of the state of the system. In the second system, the internal state is estimated by the sequential analysis of noise signals. (HDR)

**14186** (CONF-750977-, pp 13.1-13.6) INCORE NEUTRON NOISE ANALYSIS. Mayo, C. W.; Currie, R. L.; Stevens, D. M.; Zigler, G. L. (Babcock and Wilcox Co., Lynchburg, VA). 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

A variety of applications for PWR incore neutron noise measurements is examined. In-core noise spectra have proven valuable for interpreting other process spectra and providing a means of monitoring the mechanical performance of fuel assemblies. All structural and fuel assembly motions detected in these investigations have been very small and have no adverse effect on plant operations. The global temperature oscillation is insignificant with respect to system design limits and presents no operational problems. This work has shown that noise analysis of incore detector signals has a direct application in reactor system surveillance and diagnosis. (auth)

**14187** (CONF-750977-, pp 15.1-15.33) ON-LINE REACTOR SURVEILLANCE ALGORITHM BASED ON MULTIVARIATE ANALYSIS OF NOISE. Piety, K. R.; Robinson, J. C. (Univ. of Tennessee, Knoxville). 1975.

From 2nd power plant dynamics, control and testing symposium; Knoxville, Tennessee, USA (3 Sep 1975).

In proceedings of the second power plant dynamics, control and testing symposium. (Tennessee Univ., Knoxville (USA). Dept. of Nuclear Engineering).

The development and demonstration of a computer-oriented approach for on-line reactor surveillance are described. A characterization of the reactor state is developed from the analysis of noise signals, and the surveillance algorithm forms a statistical description of normal behavior from this characterization. Hyperellipsoids constructed from this description are used to enclose normal regions of behavior in the multi-dimensional measurement space which represents all possible reactor states. When measurements falling outside of normal regions are detected, the status of the reactor is suspect. This algorithm has been implemented on a minicomputer and has demonstrated its effectiveness in on-line tests. An experiment at the High Flux Isotope Reactor demonstrated the ability of the algorithm to sense changes in reactor conditions that the plant instrumentation could not detect. (auth)

**14188** (CONF-751101-36) ON-LINE REACTOR SURVEILLANCE ALGORITHM BASED ON MULTIVARIATE ANALYSIS OF NOISE. Piety, K. R.; Robinson, J. C. (Tennessee Univ., Knoxville (USA)). 1975. 6p. Dep. NTIS $4.00.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

A mini-computer based surveillance algorithm for monitoring signals from nuclear power plants to provide advanced warning of anamalous conditions has been developed and implemented for on-line applications. The reactor state is characterized by the analysis of noise signals. During an observation period when

normal conditions prevail, the surveillance algorithm utilizes these noise characterizations to form a statistical description of normal reactor behavior. At the conclusion of this observation period, the surveillance algorithm examines each new incoming characterization to determine if it differs significantly from the normal description. (auth)

**14189** (HEDL-SA-956) SCRAM: A PROGRAM FOR CALCULATING SCRAM TIMES. Bourquin, R. D.; Birney, K. R. (Hanford Engineering Development Lab., Richland, Wash. (USA)). 15 May 1975. 18p. (CONF-751101-65). Dep. NTIS $4.50.

From joint meeting of the American Nuclear Society and the Atomic Industrial Forum; San Francisco, California, USA (16 Nov 1975).

Prediction of scram times is one facet of design analysis for control rod assemblies. Parameters for the entire control rod sub-system must be considered in such analyses and experimental verification is used when it is available. The SCRAM computer program was developed for design analysis of improved control rod assemblies for the Fast Flux Test Facility (FFTF). A description of the evolution of the program from basic equations to a functional design analysis tool is presented. (auth)

**14190** ESTIMATION AND OPTIMAL FEEDBACK CONTROL THEORY APPLIED TO A NUCLEAR BOILING WATER REACTOR. Frogner, B.; Grossman, L. M. (Univ. of California, Berkeley). Nucl. Sci. Eng.; 58: No. 3, 265-277(Nov 1975).

A linear dynamic model, a quadratic performance index, and a Gaussian stochastic noise assumption (LQG-theory) have been used to design a feedback controller for a simulated current design 1100-MW(e) boiling water reactor. The total plant power control is studied in the range of 65 to 100 percent of rated power, with main emphasis on load-following control. An extended Kalman filter used in parallel with the compensator during normal operation is suggested for on-line parameter estimation. The algorithms are considered suitable for implication in direct digital control. (auth)

**14191** NUCLEAR REACTOR WITH AN IMPROVED CONTROL SYSTEM. Hosegood, S. B.; Lockett, G. E. (to Commission of the European Communities). French Patent 2,217,772/A/. 7 Feb 1974. Priority date 9 Feb 1973, United Kingdom of Great Britain and Northern Ireland (UK). 12p. (In French)

Available from Institut National de la Propriete Industrielle, Paris (France).

The control system is characterized by a flexible neutron absorbing element such as one neutron absorbing chain which is lowered into the core of the reactor in such a fashion that its action begins below the reactor core. The rise and fall of the chain is assured by a pulley mechanism and scram is obtained by a free fall of the chain whose upper end is always fastened to the pulley so that it may be withdrawn. Such a control system is particularly suitable for a high-temperature gas-cooled reactor. (tr-FR)

**14192** TRAINING ANNULAR REACTOR SR-3P WITH RADIAL CONTROL. Zeman, J. (Ceske Vysoke Uceni Technicke, Prague (Czechoslovakia). Fakulta Jaderna a Fysikalne Inzenyrska). Acta Polytech. (Prague), IV; No. 3, 75-82(1973). (In Czech).

From scientific conference of the Czech Technical University; Prague, Czechoslovakia (12 Jun 1973).

The method and the results are briefly described of the physical computation of the annular reactor SR-3P radial control. The proposed control is shown to comply with requirements for nuclear reactor control systems. It is also shown that the motion of control assemblies only negligibly affects the course of neutron flux in the central experimental region. (INIS)

**14193** ON-LINE COMPUTER CONTROL OF NEUTRON FLUX SPATIAL DISTRIBUTION. Filipchuk, E. V.; Potapenko, P. T.; Dunaev, V. G.; Kuznetsov, N. A.; Fedulov, V. V. At. Energ. (USSR); 39: No. 1, 12-16(Jul 1975). (In Russian).

The problem of constructing a neutron flux spatial control system on the basis of an on-line computer is considered. For spatial control, the reactor is divided into zones, each zone having a detector and control rod. The absolute stability of the multi-dimensional non-linear sample data system is investigated on the basis of Tsypkin and Juri-Lee criteria. The quality of the processes in the system is evaluated by means of the state variables. The mathematical analysis is based on the adiabatic node model of reactor kinetics. (auth)

## Nuclear Power Plant Economics

*Refer also to abstracts 11951 and 14130.*

**14194** (BNWL-SA-5525) NUCLEAR OPTION. Schmid, L. C. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). 1975. Contract E(45-1)-1830. 15p. (CONF-750746-1). Dep. NTIS $4.50.

From bend in the river conference; Bend, Oregon, USA (5 Jul 1975).

The comparison of coal, oil, and nuclear energy as sources of electric power for the U. S. is presented. Economic and safety aspects are considered. (DCC)

**14195** (ITU-12) THE ECONOMIC COMPARISON OF NUCLEAR REACTORS OF 350 AND 500 MW(e) FOR DEVELOPING COUNTRIES. Aybers, N.; Kakac, S.; Bayulken, A.; Gencay, A. (Istanbul Technical Univ. (Turkey). Inst. for Nuclear Energy). 1974. 208p. INIS.

The main purpose of the present study is to discuss in detail the economic status of nuclear energy and illustrate the approach to economic feasibility with a special reference to problems faced by developing countries. The present research project has been proposed to carry out a study on the economic comparison of two reactors of 350 and 500 MW(e) for a developing country that has a call for bids for a 400 MW(e) nuclear power station. This comparison includes investment costs, effect of local conditions, cost of first charge, fuel cycle cost, annual cost of operation, and cost of energy. (INIS)

**14196** THE POTENTIAL OF NUCLEAR FUEL IN MEETING THE ENERGY NEEDS IN INDIA. Meckoni, V. N.; Balakrishnan, M. R. (Bhabha Atomic Research Centre, Bombay (India)). Phys. News; 5: No. 3, 95-99(Sep 1974).

3 figures.

An attempt is made to focus attention on the energy crisis prevailing in the world today. The potential of nuclear power to meet the increasing demands on energy and the continuous depletion of coal is explained. The role of thermal reactors with $^{238}U$ or $^{235}U$ as fuel and fast reactors with $^{239}Pu$ or $^{233}U$ as fuel are discussed. The significance of development of breeder reactors for nuclear power in India utilizing the available resources of $^{232}Th$ and uranium is brought out. The energy potential of coal and uranium in India are compared. It is pointed out that there is a distinct possibility that the present nuclear power programme based on the CANDU reactors would make sufficient quantity of $^{239}Pu$ and $^{233}U$ available to fuel more breeder nuclear power stations to generate electricity as well as to fuel other types of nuclear reactors for the purpose of ship propulsion and for steel making. (INIS)

## Reactor Fuel Cycle Economics

**14197** (BNWL-B-437) STATUS REPORT: CONCEPTUAL FUEL CYCLE STUDIES FOR THE HANFORD NUCLEAR ENERGY CENTER. Merrill, E. T.; Fleischman, R. M. (Battelle Pacific Northwest Labs., Richland, Wash. (USA)). Jul 1975. Contract AT(45-1)-1830. 43p. Dep. NTIS $4.00.

A summary is presented of the current status of studies to determine the logistics of onsite plutonium recycle and the timing involved in introducing the associated reprocessing and fabrication fuel cycle facilities at the Hanford Nuclear Energy Center. (auth)

**14198** ENERGY BALANCE IN LWR AND LMFBR BURNUP AND PRODUCTION OF FISSILE NUCLEI. Schwartz, J. P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 – Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees); Ravier, J. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 – Saint-Paul-les-Durance (France). Dept. des Reacteurs a Neutrons Rapides). pp 156-159 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The basic data that were used to evaluate the fuel cost of both LWR and LMFBR in the 1000 MW(e) power range are presented. Different hypotheses are made concerning the use of the fuel. The comparison leads to some remarks about the economic interest of both types of reactor. (FR)

**14199** REFUELING POLICY AND ELECTRICAL NETWORK NEEDS. Peltier (Electricite de France, 75 – Paris. Service de la Production Thermique); Millat (Electricite de France, 75 – Paris. Service des Mouvements d'Energie); Brandt (Electricite de France, 92 – Courbevoie. Service Etudes et Projets Thermiques et Nucleaires). pp 153-154 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

It is shown that fuel management procedures must be flexible enough to accomodate all the situations imposed by technical, economical or hazardous constraints due to the grid. (FR)

**14200** PWR FUEL LOADING OPTIMIZATION. Martinet, M. (Groupement pour les Activites Atomiques et Avancees (GAAA), 92 – Le Plessis-Robinson (France)); Santamarina, A. (CEA Centre d'Etudes Nucleaires de Saclay, 91–Gif-sur-Yvette (France). Dept. de Physique des Reacteurs et de Mathematiques Appliquees). pp 143-144 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

It is shown that the computer program ZODIA, used in parallel with a 2-D diffusion program, is able to provide several optimized PWR loadings at beginning of cycle. The choice among these loadings may be done, using form factor and burnup evolution studies. (FR)

**14201** STUDY OF POSSIBLE FAST BREEDER REACTOR PENETRATION STRATEGIES IN EUROPE. Effantin, M.; Israel, S.; Montfort, J.; Pasquet, J. P. (Electricite de France, Clamart). pp 154-156 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

The objective of the studies presented is to assess the impact of various strategies of fast breeder reactor construction on the requirements for fissile materials. Two points were selected as of particular importance: the consequence of fueling fast reactors with enriched uranium and the sensitivity of the results to some of reactors' characteristics. (FR)

**14202** FUEL MANAGEMENT IN CANDU REACTORS. Millar, C. (Atomic Energy of Canada Ltd., Chalk River, Ontario). pp 139-140 of La Maturite de l'Energie Nucleaire. Lehoulier, J.; Mantega, M. (eds.). Clamart, France; Societe Francaise de l'Energie Nucleaire (1975). (In French)

From 1st European nuclear conference; Paris, France (21 Apr 1975).

Fuel management schemes and fueling patterns chosen for CANDU-type reactors are presented. The problems encountered during refueling are underlined. (FR)

## Reactor Licensing and Regulation

*Refer also to abstract 14034.*

**14203** (CONF-750827--, pp 31-45) DECOMMISSIONING AND DECONTAMINATION OF LICENSED REACTOR FACILITIES AND DEMONSTRATION NUCLEAR POWER PLANTS. Lear, G.; Erickson, P. B. (Nuclear Regulatory Commission, Washington, DC). Sep 1975.

From conference on decontamination and decommissioning of ERDA facilities; Idaho Falls, Idaho, USA (19 Aug 1975).

In proceedings of the first conference on decontamination and decommissioning (D and D) of ERDA facilities. (Energy Research and Development Administration, Idaho Falls, Idaho (USA). Idaho Operations Office; Aerojet Nuclear Co., Idaho Falls, Idaho (USA)).

Decommissioning of licensed reactors and demonstration nuclear power plants has been accomplished by mothballing (protective storage), entombment, and dismantling or a combination of these three. The alternative selected by a licensee seems to be primarily based on cost. A licensee must, however, show that the decommissioning process provides adequate protection of the health and safety of the public and no adverse impact on the environment. To date the NRC has approved each of the alternatives in the decommissioning of different facilities. The decommissioning of small research reactors has been accomplished primarily by dismantling. Licensed nuclear power plants, however, have been decommissioned primarily by being placed in a mothballed state in which they continue to retain a reactor license and the associated licensee responsibilities. (auth)

**14204** (DOCKET-50267-336) FORT ST. VRAIN NUCLEAR GENERATING STATION. Semiannual Operations Report, January–June 1975. (Public Service Co. of Colorado, Denver (USA)). 10 Sep 1975. 139p. Dep. NTIS $10.00.

The reactor was in start-up testing during this period. Information is presented concerning fuel and equipment performance; changes in facility design; procedures, testing; staff; licensed operator training; surveillance; power generation; maintenance; shutdowns; primary coolant chemistry; radiation exposure; fission product release; solid wastes; and radioactive effluents. (FS)

**14205** (DOCKET-50289-521) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. First Year Commercial Operating Report. (Metropolitan Edison Co., Reading, Pa. (USA)). 17 Nov 1975. 4p. Dep. NTIS $4.50.

One year of commercial operation was completed on September 2, 1975. Cumulative unit availability and capacity factors of 87.0 percent and 84.8 percent respectively were attained. Summaries are presented concerning reassessment of safety analysis for variance from specification; assessment of structures, systems, and components important to safety; and progress and status of items requiring additional information. (FS)

**14206** (FIND-50338-R1) FIND: NORTH ANNA POWER STATION, UNITS 1 AND 2. Williams, W. H. (ed.). (Nuclear Regulatory Commission, Washington, D. C. (USA)). Dec. 1975. 24p. Dep. NTIS $4.00.

An index is presented for the docket report material submitted in conjunction with the application for a nuclear power plant construction permit and operating license. The index citations are to the beginnings of major headings, sections, responses, etc., and refer to grid coordinates on microfiche sheets prepared for each docket report. (DG)

**14207** (JAJ-TR-1) TOPICAL QUALITY ASSURANCE REPORT FOR CONSTRUCTION PHASE OF NUCLEAR POWER PLANTS. (Jones (J.A.) Construction Co., Charlotte, N. C. (USA)). Oct 1975. vp. J. A. Jones Construction Co., Charlotte, NC.

A quality assurance program for use during the construction phase of nuclear power plants is presented. (JWR)

**14208** (REG/G-1.13(Rev.1)(12-75)) SPENT FUEL STORAGE FACILITY DESIGN BASIS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Dec 1975. 3p. NUREG.

Requirements are specified relating to prevention of loss of water from the spent fuel storage pool and mechanical damage to fuel. (DG)

**14209** (REG/G-1.68.1(12-75)) PREOPERATIONAL AND INITIAL STARTUP TESTING OF FEEDWATER AND CONDENSATE SYSTEMS FOR BOILING WATER REACTOR POWER PLANTS. (Nuclear Regulatory Commission, Washington, D. C. (USA). Office of Standards Development). Dec 1975. 3p. NUREG.

Requirements are specified in the areas of preoperational and startup testing and in documentation. (DG)

# GENERAL AND MISCELLANEOUS

## Law

**14210** (ERDA-tr-77) LAW ON CONDUCT OF ACTIVITIES IN THE NUCLEAR FIELD IN THE SOCIALIST REPUBLIC OF ROMANIA. 1974. Translated from Buletinul oficial al Republicii Socialiste Romania, Part I, No. 136. 15p. Dep. NTIS $4.50.

Details are given of a law that incorporates provisions designed to ensure the introduction, development and use of nuclear energy and nuclear techniques in the economy and in public life, the development of scientific research in this field, and industrial application of the results of such research on the basis of a national nuclear program. (auth)

## Management

**14211** (INIS-mf-1772) DANISH ATOMIC ENERGY COMMISSION ANNUAL REPORT 1 APRIL 1973–31 MARCH 1974. (Atomenergikommissionen, Copenhagen (Denmark)). Oct 1974. 158p. (In Danish). INIS.

With list of staff publications.

Activities of the Danish Atomic Energy Commission and the Risø Research Establishment for the period April 1, 1973, to March 31, 1974, are summarized. The operations of the various facilities at the Research Establishment are revised. Operating staff levels and financial data are tabulated, and a list of staff publications is given. (INIS)

**14212** (INIS-mf-1822) CSIRO TWENTY-SIXTH ANNUAL REPORT 1973/74. (Commonwealth Scientific and Industrial Research Organization, Canberra (Australia)). 1974. 102p. INIS.

Research programs from each division are outlined. Accounts and a financial statement are included. (INIS)

**14213** (INIS-mf-1823) TWENTY-SECOND ANNUAL REPORT 1973-74. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1974. 116p. INIS.

Contents include a review of world and Australian nuclear power developments, uranium supply, demand and processing, uranium enrichment, radioisotopes and radiation. Staff research activities and publications are listed. Accounts are itemized. (INIS)

**14214** (INIS-mf-1824) LIST OF REPORT PUBLICATIONS. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Apr 1974. 97p. INIS.

This publication lists all unclassified technical reports in the AAEC/E, AAEC/TM, AAEC/M and AAEC/Trans series, issued by the A.A.E.C. Research Establishment since 1958. It supersedes entirely the List of Report Publications issued in April 1972. An alphabetical author index and a KWIC index to the titles are included. The publications listed were all issued from the Research Establishment. They have been submitted to the U.S.A.E.C.'s Technical Information Center for inclusion in Nuclear Science Abstracts, and more recently to the I.A.E.A. for inclusion in the International Nuclear Information System. Copies are held by major libraries and nuclear research establishments around the world. Gaps in the numerical series usually correspond to titles not cleared for general issue. The listing was prepared on an IBM 360/501 computer by the Research Establishment's Library in co-operation with the Applied Mathematics and Computing Section. (auth)

**14215** (INIS-mf-1834) DARESBURY 1974. (Science Research Council, Daresbury (UK). Daresbury Lab.). 1975. 52p. INIS.

Available from Science Research Council, Daresbury Laboratory, Daresbury, Warrington.

The report includes the following topics: high energy physics (NINA operations and research programme; CERN programme–technical support and experimental and theoretical studies); synchrotron radiation (synchrotron radiation facility, theory, synchrotron radiation source); nuclear structure (Nuclear Structure Facility Tandem, building the NSF, research and development programmes); computer systems. Appendices give information on finance and administration; health and safety; publications. (INIS)

**14216** (UCRL-50025-75-4) ELECTRONIC ENGINEERING DEPARTMENT QUARTERLY REPORT NO. 4, 1975. (California Univ., Livermore (USA). Lawrence Livermore Lab.). 8 Oct 1975. Contract W-7405-Eng-48. 29p. Dep. NTIS $4.00.

Separate abstracts were entered for the seven sections of this progress report. Five were included in Nuclear Science Abstracts, and all seven were included in ERDA Research Abstracts. (SFL)

*For abstracts of individual sections see: 12169–12171 and 12351.*

**14217** EMPLOYMENT SITUATION IN THE CIVILIAN NUCLEAR SECTOR. Study Bearing on Thirteen European Countries. Rembser, J. (Bundesministerium fuer Forschung und Technologie, Bonn (F. R. Germany)). Prog. Sci.; No. 175, 45-53 (Mar 1975). (In French)

Thirteen European countries have supplied facts on the employment situation in 1973. For research purposes the data collected were analysed according to sectors of activity and qualification levels. The study covers all civilian nuclear personnel in industry and in the laboratories and services of national and international public organizations. (FR)

**14218** DISTRIBUTION OF KNOWLEDGE IN ANALYTICAL CHEMISTRY. Richez, J.; Platzer, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Div. de Chimie). Bull. Inf. Sci. Tech. (Paris); No. 200, 135-137(Feb 1975). (In French)

The CEA contributes to the development of knowledge in analytical chemistry by research work in its laboratories, at the same time using the acquired information for the daily execution of many determinations. In its own interest the CEA must therefore pass on this know-how to those who carry out analyses on its behalf: the analytical laboratories and the analysts themselves. At the analytical laboratory level the Committee for the Establishment of analytical methods (CETAMA) offers a permanent liaison service, where analysts are concerned. Close relations with educational or professional training establishment enable CEA personnel to attend causes and instruction periods as students or to collaborate as instructors. The work of the CETAMA and the educational and professional training activities to which the CEA contributes in the field of analytical chemistry are outlined. (FR)

## Mathematics and Computers

*Refer also to abstracts 12138, 12761, 12762, 13114, and 13721.*

**14219** (CEA-N-1791, pp 61-62) VARIAN COMPUTERS. Aguer, M.; Fouan, J. P.; Moreau, R. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

Beside on-line processing of multiparameter events, two Varian 620 computers have been extensively used for integrated data handling. Records of kinematics and monitoring parameters are transmitted with each spectrum for off-line analysis. An assembly system DAS for Varian 620 has been written in Fortran IV. The 10020 real batch monitor has been transformed in a real time sharing monitor. (FR)

**14220** (CEA-N-1791, pp 201-202) OPERATION OF THE T1600 COMPUTER. Sanche, M. [nd]. (In French)

In Department of Nuclear Physics. Progress report 1 October 1973–30 September 1974.

The T 1600 computer is in operation for "on line" experiments, allowing the data storage in its own memory and/or the periodical reading of memory blocks pertaining to different experiments. The way of using the computer for "off line" tasks, in particular for data reduction is multi-parameter experiments, is now investigated. (FR)

**14221** (UCCND-CSD-2) SUBJECTIVE PROBABILITY ESTIMATES OF RESOURCES MODEL: PROGRAM USER'S MANUAL. Van Wie, N. H. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). Dec 1975. Contract W-7405-eng-26. 122p. Dep. NTIS $5.45.

The objectives of the Subjective Probability Estimates of Resources Model are conversion of estimates concerning mineral resources expressed in probabilistic terms into mean or "most likely" values; accumulation of these estimates into mean values for a sub-area of land and derivation of secondary attributes of the mineral deposit; aggregation of the information concerning the sub-areas into overall area estimates; application of an economic model to these estimates to derive estimates of the cost of developing, extracting, and milling the mineral; statistical comparisons of estimates of geologists grouped by using a self-appraisal index of confidence; and preparation of reports, both tabular and

graphic, that present the results. This report describes the computer programs that implement these objectives. The application of them to a study of the potential for uranium resources in undiscovered deposits in New Mexico has been described elsewhere. [GJO-109]. 3 figures, 2 tables. (auth)

**14222** (UCCND-CSD-4) SUBJECTIVE PROBABILITY ESTIMATE DATA BASE MANAGEMENT PROGRAMS. Program User's Manual. Van Wie, N. H. (Union Carbide Corp., Oak Ridge, Tenn. (USA). Nuclear Div.). Dec 1975. Contract W-7405-eng-26. 62p. Dep. NTIS $5.45.

The subjective probability assessment of uranium resources requires the analysis of resource estimates provided by a number of geologists relative to a number of geographic areas. These estimates have been provided by GJO in machine-readable form. A group of programs was prepared to make these estimates readily accessible for EDP-based analysis by the Delphi and Monte Carlo programs described in UCCND-CSD-2 and -3. The ability to print any given estimate in the format of the questionnaire sheet (the interface with the geologist) is included. These utility programs are described herein. 1 figure (auth)

**14223** EIGENVALUE WITH HIGHEST REAL PART IN A TYPE OF MATRICES. Delattre, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 -- Gif-sur-Yvette (France). Groupe d'Etudes des Effets des Rayonnements sur les Structures Moleculaires). C. R. Hebd. Seances Acad. Sci., Ser. A, B; 280: No. 14, 925-928(14 Apr 1975). (In French)

There are many theorems concerning the eigenvalues of matrices with dominant main diagonal, but very few when this condition is not satisfied. The theorem here proposed belongs to this second category. (FR)

**14224** A NEW VERSION OF AAKF (REDUCED TENSOR MATRIX ELEMENTS) ADAPTED TO SPECTROSCOPIC NOTATION. Froese Fischer, C.; Saxena, K. M. S. (Waterloo Univ., Ontario (Canada). Dept. of Applied Mathematics). Comput. Phys. Commun.; 9: No. 6, 370-380(Jun 1975).

This program is a revision of Robb's TENSOR program which enables one to calculate reduced matrix elements of summations of one-particle tensor operators: recent corrections are included. The purpose of the revision is two-fold. Firstly, the formats for the input data and the printed output are changed to more compact and readable spectroscopic notation. Secondly, it modified the punched output format so that the results may be read directly by other programs such as a transition probability program. (auth)

**14225** A GENERAL PURPOSE MONTE-CARLO PROGRAM. Dufour, P.; Schlesinger, J. (Mons Univ. (Belgium)). Comput. Phys. Commun.; 9: No. 6, 360-369(Jun 1975).

This program is designed to estimate the propagation of errors and to simulate simple stochastic processes. The program generates the distribution associated with a function of several random variables which is coded by the user. The distributions followed by the random variables are specified either by an analytical formula or numerically. The variables are generated by a Monte-Carlo method. (auth)

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